IBM System Storage TS3310 Tape Library

Maintenance Information for IBM Service Personnel

Machine Type 3576

GA32-0478-09

IBM System Storage TS3310 Tape Library

Maintenance Information for IBM Service Personnel

Machine Type 3576

GA32-0478-09

Note!

Before using this information and the product it supports, be sure to read the general information under "Notices" in the Appendix.

To ensure that you have the latest publications, visit the web at **http://www.ibm.com/storage/lto**.

Released July 2011

This edition applies to the *IBM System Storage™ TS3310 Tape Library Maintenance Information*,GA32-0478-09, and to the subsequent releases and modifications until otherwise indicated in new editions.

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Read This First

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications Networks.

Accessing Online Technical Support

It is the customer's responsibility to set up this tape drive or library and to ensure that the drive and library have the latest firmware (unless you have purchased a service contract).

For online Technical Support, visit http://www.ibm.com/support/.

For latest firmware and diagnostics, please visit http://www.ibm.com/support/.

Sending Us Your Comments

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  Department GZW
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Registering for My Notification

My Notification registration provides email notification when firmware levels have been updated and are available for download and installation. To register for My Notification:

1. Visit the web at: http://www-01.ibm.com/software/support/einfo.html..
2. Click **My Notifications.**

Note: Library firmware and tape drive firmware are verified and released together. When updating, verify that all installed components such as tape drive and library firmware are at the latest levels noted on the Support website.

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Mixing different levels of library and tape drive firmware is not supported and might cause unpredictable results.

Contacting IBM Technical Support

In the USA: Call 1-800-IBM_SERV (1-800-426-7378).

Note: Before calling, complete all the steps in "Contacting IBM Technical Support" on page 6-45

All other Countries/Regions: Visit http://www.ibm.com

To open a Service Request online: Under **Support & downloads**, click **Open a service request**.

Minimum Firmware Levels for Common Library Features

Feature	Minimum Firmware Levels Required
LTO 5 Tape Drive (Feature Code 8242)	Library firmware must be at 587G.GS003 or greater, to support the Ultrium 5 drives. If using the IBM Tape Device Driver or ITDT (IBM Tape Diagnostic Tool), ensure the minimum version required to support Ultrium 5 tape drives are installed on the host. Ensure any host applications and software that use their own device drivers are at the minimum level required to support Ultrium 5 tape drives.

Limits on Downgrading Library Firmware

If your library is running firmware version 600G or later, you can only downgrade library firmware to 410G or later. If you need to downgrade to a version earlier than 410G, contact IBM Technical Support.

Limits on Restoring a Saved Configuration

If your library is running firmware version 600G or later, you can restore a saved configuration that was created with only firmware version 410G or later. If you need to restore a configuration created with a firmware version earlier than 410G, contact IBM Technical Support.

Summary of Changes for GA32-0478-09

Revision bars (|) appear next to all of the information that has been added or changed since the previous edition (GA32-0478-08).

New Information

The following topics are new to this edition:

- Registering for My Notification
- Contacting IBM Technical Support
- Minimum Firmware Levels for Common Library Features
- Limits on Downgrading Library Firmware
- Limits on Restoring a Saved Configuration
- CAN Bus Tool Kit
- These new topics have been added to the Internal Components section:

  FRU Replacement Strategy for Model 1 and Model 2 Robots

  Removing the Model 1 Robot Assembly from the Library

  Installing the Model 1 Robot Assembly in the Library

  Removing and Replacing the Model 1 Picker Assembly from the Y-Carriage Assembly Inside the Library

  Removing and Replacing the Model 1 Y-Carriage Assembly

Changed Information

The following topics have been updated:

- Read This First
- Saving/Restoring System Configuration
- DR006: Resolve Unload Timeout
- CRUs and FRUs
- Appendix A: TapeAlert Flags Supported by the Drive

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Safety and Environmental Notices

This section contains information about safety notices that are used in this guide and environmental notices for this product.

Safety Notices

Observe the safety notices when using this product. These safety notices contain danger and caution notices. These notices are sometimes accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the *IBM Systems Safety Notices*, G229–9054 manual.

The sections that follow define each type of safety notice and give examples.

Danger Notice

A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:

DANGER: An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. *(D004)*

Caution Notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A generally hazardous condition not represented by other safety symbols.
 Class II	This product contains a Class II laser. Do not stare into the beam. (*C029*) Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).
	A hazardous condition due to mechanical movement in or around the product.

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If the symbol is...	It means...
	This part or unit is heavy but has a weight smaller than 18 kg (39.7 lb). Use care when lifting, removing, or installing this part or unit. (*C008*)

Sample caution notices follow:

Caution

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (*C007*)

Caution

The system contains circuit cards, assemblies, or both that contain lead solder. To avoid the release of lead (Pb) into the environment, do not burn. Discard the circuit card as instructed by local regulations. (*C014*)

Caution

When removing the Modular Refrigeration Unit (MRU), immediately remove any oil residue from the MRU support shelf, floor, and any other area to prevent injuries because of slips or falls. Do not use refrigerant lines or connectors to lift, move, or remove the MRU. Use handholds as instructed by service procedures. (*C016*)

Caution

Do not connect an IBM control unit directly to a public optical network. The customer must use an additional connectivity device between an IBM control unit optical adapter (that is, fibre, ESCON®, FICON®) and an external public network . Use a device such as a patch panel, a router, or a switch. You do not need an additional connectivity device for optical fibre connectivity that does not pass through a public network.

Possible Safety Hazards

Possible safety hazards to the operation of this product are:

Electrical

An electrically charged frame can cause serious electrical shock.

Mechanical

Hazards (for example, a safety cover missing) are potentially harmful to people.

Chemical

Do not use solvents, cleaners, or other chemicals not approved for use on this product.

Before using the library, repair any of the preceding problems.

Class I Laser Product

The library may contain a laser assembly that complies with the performance standards set by the U.S. Food and Drug Administration for a Class I laser product. Class I laser products do not emit hazardous laser radiation. The library has the necessary protective housing and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies have reviewed the library and have obtained approvals to the latest standards as they apply.

Protective Devices

The library has the following protective devices:

- Monitored access to the library
- Main power switch

Monitored Access to the Library

The library is completely surrounded by an enclosure. The library can be accessed only from monitored access areas.

The enclosure around the library separates the danger area of the library from the working area. The danger area is the area in which personnel can be injured by component movements.

CAUTION:
Movements of mechanical components in the library can cause serious injury. Access to the library should be restricted to authorized personnel only.

Main Power Switch

To turn library power ON, press | on each power switch installed in the library. To turn library power OFF, press 0 on the switch. In any case of danger, immediately turn the main power switch of the library OFF.

CAUTION:
To completely remove all power, disconnect the power cord from the electrical outlet.

Attention: Except in emergencies, stop the library with the normal shutdown procedure before you switch OFF the main power switch. IBM is not responsible for damage caused by improper use of the main power switch. Such risk lies entirely with the user.

CAUTION:
Movements of mechanical components in the tape library can cause serious injury. Before turning the main power switch ON and restarting the tape library, confirm that no danger exists to personnel or property.

Rack Safety

The following general safety information should be used for all rack mounted devices.

DANGER

- **Always lower the leveling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Rack mounted devices are not to be used as a shelf or work space. Do not place any object on top of rack mounted devices.**
- **Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet before servicing any device in the rack cabinet.**
- **Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.**
- **An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.**

CAUTION:

- **Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack mounted devices.**
- **Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.**
- **Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.**
- *(For sliding drawers)* **Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack may become unstable if you pull out more than one drawer at a time.**
- *(For fixed drawers)* **This drawer is a fixed drawer and should not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack may cause the rack to become unstable or cause the drawer to fall out of the rack.**

(R001)

CAUTION:
Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building:

- **Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must do the following:**
  - **Remove all devices in the 32U position and above.**
  - **Ensure that the heaviest devices are installed in the bottom of the rack cabinet.**
  - **Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.**
- **If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.**
- **Inspect the route that you plan to take to eliminate potential hazards.**
- **Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.**
- **Verify that all door openings are at least 760 x 2032 mm (30 x 80 in.).**
- **Ensure that all devices, shelves, drawers, doors, and cables are secure.**
- **Ensure that the four leveling pads are raised to their highest position.**
- **Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.**
- **Do not use a ramp inclined at more than ten degrees.**
- **Once the rack cabinet is in the new location, do the following:**
  - **Lower the four leveling pads.**
  - **Install stabilizer brackets on the rack cabinet.**
  - **If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.**
- **If a long distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off of the pallet and bolt the rack cabinet to the pallet.**

(R002)

Power cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

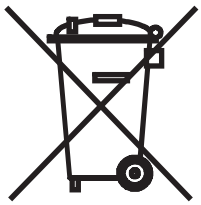
Product recycling and disposal

This unit contains recyclable materials.

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet sites at http://www.ibm.com/ibm/recycle/us/index.shtml and http://www.ibm.com/ibm/environment/products/index.shtml

Note: This paragraph is also translated into Spanish as follows:

> Esta unidad debe reciclarse o desecharse de acuerdo con lo establecido en la normativa nacional o local aplicable. IBM recomienda a los propietarios de equipos de tecnología de la información (TI) que reciclen responsablemente sus equipos cuando éstos ya no les sean útiles. IBM dispone de una serie de programas y servicios de devolución de productos en varios países, a fin de ayudar a los propietarios de equipos a reciclar sus productos de TI. Se puede encontrar información sobre las ofertas de reciclado de productos de IBM en el sitio web de IBM http://www.ibm.com/ibm/environment/products/index.shtml



Notice: This mark applies only to countries within the European Union (EU) and Norway.

Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

Remarque : Cette marque s'applique uniquement aux pays de l'Union Européenne et à la Norvège.

L'etiquette du système respecte la Directive européenne 2002/96/EC en matière de Déchets des Equipements Electriques et Electroniques (DEEE), qui détermine les dispositions de retour et de recyclage applicables aux systèmes utilisés à travers l'Union européenne. Conformément à la directive, ladite étiquette précise que le produit sur lequel elle est apposée ne doit pas être jeté mais être récupéré en fin de vie.

注意: このマークは EU 諸国およびノルウェーにおいてのみ適用されます。

この機器には、EU 諸国に対する廃電気電子機器指令 2002/96/EC(WEEE) のラベルが貼られています。この指令は、EU 諸国に適用する使用済み機器の回収とリサイクルの骨子を定めています。このラベルは、使用済みになった時に指令に従って適正な処理をする必要があることを知らせるために種々の製品に貼られています。

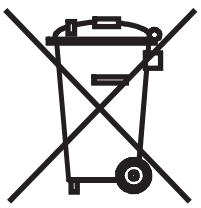
In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

Battery return program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to http://www.ibm.com/ibm/environment/products/index.shtml or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

The following applies for countries within the European Union:



For Taiwan:

Please recycle batteries.

廢電池請回收

Batteries or packaging for batteries are labeled in accordance with European Directive 2006/66/EC concerning batteries and accumulators and waste batteries and accumulators. The Directive determines the framework for the return and recycling of used batteries and accumulators as applicable throughout the European Union. This label is applied to various batteries to indicate that the battery is not to be thrown away, but rather reclaimed upon end of life per this Directive.

Les batteries ou emballages pour batteries sont étiquetés conformément aux directives européennes 2006/66/EC, norme relative aux batteries et accumulateurs en usage et aux batteries et accumulateurs usés. Les directives déterminent la marche à suivre en vigueur dans l'Union Européenne pour le retour et le recyclage des batteries et accumulateurs usés. Cette étiquette est appliquée sur diverses batteries pour indiquer que la batterie ne doit pas être mise au rebut mais plutôt récupérée en fin de cycle de vie selon cette norme.

バッテリーあるいはバッテリー用のパッケージには、EU 諸国に対する廃電気電子機器指令 2006/66/EC のラベルが貼られています。この指令は、バッテリーと蓄電池、および廃棄バッテリーと蓄電池に関するものです。この指令は、使用済みバッテリーと蓄電池の回収とリサイクルの骨子を定めているもので、EU 諸国にわたって適用されます。このラベルは、使用済みになったときに指令に従って適正な処理をする必要があることを知らせるために種々のバッテリーに貼られています。

In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and treatment of batteries and accumulators. Customer participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances. For proper collection and treatment, contact your local IBM representative.

Spain

This notice is provided in accordance with Royal Decree 106/2008 of Spain: The retail price of batteries, accumulators and power cells includes the cost of the environmental management of their waste.

Este aviso se proporciona de conformidad con, además de otros requisitos, el Real Decreto español 106/2008: El precio de venta al público de las baterías, los acumuladores y las celdas de potencia incluye el coste de la gestión de su desecho.

Perchlorate Material - California

Special handling may apply. See http://www.dtsc.ca.gov/hazardouswaste/perchlorate for more information.

The foregoing notice is provided in accordance with California Code of Regulations Title 22, Division 4.5 Chapter 33. Best Management Practices for Perchlorate Materials. This product, part or both may include a lithium manganese dioxide battery which contains a perchlorate substance.

Removing a Battery from a SnapHat Battery Holder

The battery for this product is located on the Library Control Card. The yellow component that holds the battery on the Library Control Card is referred to as a "SnapHat," because it snaps on the Library Control Card and is identified by its yellow color.

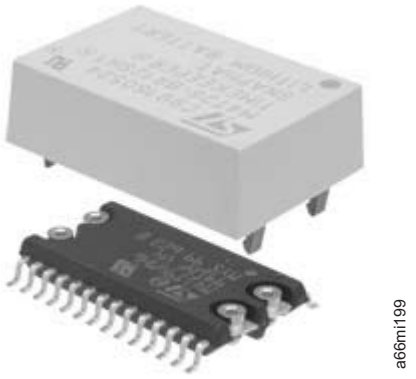


Figure 1. SnapHat battery holder

To remove the SnapHat battery holder from the Library Control Card:

1. Take the SnapHat holder by the short edges and pull it or snap it off the card.
2. When the SnapHat battery holder is free, dispose of the battery that is in the holder according to the proper battery disposal practices for your location.

Monitor recycling or disposal

Flat panel display

The fluorescent lamp or lamps in the liquid crystal display contain mercury. Dispose of it as required by local ordinances and regulations.

Monitors and Workstations

New Jersey - For information about recycling covered electronic devices in the State of New Jersey, go to the New Jersey Department of Environmental Protection web site at http://www.state.nj.us/dep/dshw/recycle/Electronic_Waste/index.html

Oregon - For information regarding recycling covered electronic devices in the state of Oregon, go to the Oregon Department of Environmental Quality site at http://www.deq.state.or.us/lq/electronics.htm

Washington State- For information about recycling covered electronic devices in the State of Washington, go to the Department of Ecology Web site at http://www.ecy.wa.gov/programs/swfa/eproductrecycle/ or telephone the Washington Department of Ecology at 1-800Recycle.

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Preface

Trained service personnel should use this maintenance information to test, diagnose, and repair the IBM System Storage TS3310 Tape Library.

To ensure that you have the latest publications, visit the web at **http://www.ibm.com/storage/lto**.

Related Publications

Refer to the following publications for additional information.

To obtain the latest version of these publications, visit the web at **http://www.ibm.com/storage/lto**.

- *IBM System Storage TS3310 Tape Library SCSI Reference* (GA32-0476) provides supported SCSI commands and protocol governing the behavior of SCSI interface.
- *IBM System Storage TS3310 Tape Library Setup and Operator Guide* (GA32-0477) provides information for installation and operation.
- *IBM Ultrium Device Driver Installation and User's Guide* (GA32-0430) provides instructions for attaching IBM-supported hardware to open-systems operating systems. It indicates what devices and levels of operating systems are supported. It also gives requirements for adapter cards, and tells how to configure hosts to use the device driver. All of the above are with the Ultrium family of devices.
- *IBM Ultrium Device Driver Programming Reference* (GC35-0483) supplies information to application owners who want to integrate their open-systems applications with IBM-supported Ultrium hardware. The reference contains information about the application programming interfaces (APIs) for each of the various supported operating-system environments.
- *IBM Encryption Key Manager Component for the Java Platform Quick Start Guide* (GA76-0420) provides a basic configuration for encryption on LTO 4 and LTO 5 tape drives.
- *IBM Encryption Key Manager Component for the Java Platform Introduction, Planning, and User's Guide* (GA76-0418) contains information to help you install, configure, and use the IBM Encryption Key Manager component for the Java platform.
- *IBM Tivoli Key Lifecycle Manager Quick Start Guide* (GI11-8738) and *IBM Tivoli Key Lifecycle Manager Installation and Configuration Guide* (SC23-9977).

  Note: *IBM Tivoli® Key Lifecycle Manager V1.0* (English) publications may be downloaded from the following Web site: **http://www.ibm.com/software/tivoli/library**.

Getting Assistance

If this document does not help you solve the problem, contact your next level of support.

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Chapter 1. Start Service

Problem Area	If...	Then...
Error Message	**Your library issues an Operator Intervention...** You will know when an Operator Intervention has been issued when the **Library**, **Drives**, or **Media** button at the bottom of the Operator Panel screen turns yellow or red. Operator Interventions are also indicated by the amber Operator Intervention Alert LED on the front panel of the library to the right of the power button, or by e-mail notifications, if this feature is enabled.	• Touch the **Library**, **Drives**, or **Media** button at the bottom of the Operator Panel screen, then touch **Operator Interventions** to view the error message(s). • After reading an error message, touch the **Resolve** button to display the suggested resolution for the problem. • Refer to Chapter 5, "Service Action Tickets (Txxx) and Diagnostic Resolutions (DRxxx)," on page 5-1 for more information about the Service Action Ticket number (T*xxx*).
	The resolution for an Operator Intervention suggests a CRU or FRU replacement...	Before replacing a CRU or FRU: • Refer to Chapter 5, "Service Action Tickets (Txxx) and Diagnostic Resolutions (DRxxx)," on page 5-1 for additional information on resolving the problem. • Observe the LEDs on all components (For more information, see "Interpreting LEDs" on page 6-17.). If the LEDs on a component indicate that there is a problem, reseat the component. • Visually check, and reseat if necessary, all of the cables that are connected to the failing FRU or CRU. For more information, see "Checking/Reseating Cables" on page 6-30. • If possible, power cycle the library. • If the error occurs again, replace the suspect component.
	A TapeAlert message was received...	Refer to Appendix A, "TapeAlert Flags Supported by the Drive," on page A-1.
	You are experiencing a problem with your library and no Operator Intervention was created...	If after trying all diagnostic procedures you are unable to resolve the problem, contact your next level of support.
	The Operator Panel displays, "Error - cannot Determine Personality"...	1. Power cycle the library. 2. If the same message appears, replace the Compact Flash Card (see "Library Control Blade or Compact Flash Card" on page 7-44.
	You get repeated errors, multiple functions surface failure messages, or T*xxx* codes...	Open and close an Access Door to ensure that all previous error handling is completed and to enable normal library robotic function.

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Problem Area	If...	Then...
	HTML error 404 appears on the computer screen when trying to launch the Web User Interface...	1. Verify that the Ethernet cable is properly connected at both ends. 2. Ping the library address to verify communication. 3. Verify network settings at host and library. 4. If the cable is properly connected, refer to "Library Control Blade or Compact Flash Card" on page 7-44.
Operator Panel	**The Operator Panel display is blank, hung, frozen, or a visual problem occurs (incorrect characters, missing characters, and so forth), dim display, or non-responsive touchscreen...**	1. Verify that power is being applied to the library. 2. Gather failure information by logging in to the Web User Interface and selecting **Service Library** > **Capture Library Log**. 3. Power cycle the library. 4. Verify that you are running the latest levels of library and drive firmware, then upgrade if necessary (see "Methods of Updating Firmware" on page 6-25. 5. If the Operator Panel display is still failing, go to "Operator Panel" on page 7-27 for instructions on replacing the display.
Media	**A cartridge leader pin has detached from the cartridge...**	Reposition the leader pin (see"Repositioning or Reattaching a Leader Pin" in the *Setup and Operator Guide* for information).
	A cartridge is not ejecting from a drive...	1. Take the logical library to which the drive is assigned offline (refer to "Taking the Drives/Library Online/Offline" on page 6-39). 2. Reset the drive (see "Resetting a Drive" on page 6-40). If the cartridge doesn't eject, continue to the next step. 3. Open the I/O Station door(s), then open the Access Door(s). 4. Locate the drive that will not eject the cartridge, then locate the blue Unload Button on the drive. 5. Press the blue Unload Button once. The Status Light located to the left of the Unload Button will flash green while the drive is rewinding and unload the cartridge. 6. If the cartridge does not eject from the drive, go to "Manual Cartridge Removal from a Drive" on page 7-132.
	Tape is broken, stretched, folded over, or wrinkled inside the cartridge...	1. Replace the tape cartridge. 2. Ensure that the latest available drive code is installed (refer to "Updating Drive Firmware" on page 6-27). If the problem continues, replace the drive (refer to "Drive Sled" on page 7-42).

Problem Area	If...	Then...
Firmware	**A firmware problem is suspected...**	Verify that you are running the latest levels of library and drive firmware, then upgrade if necessary (see "Methods of Updating Firmware" on page 6-25). If new firmware does not resolve the problem, contact your next level of support.
	The Library firmware does not complete the boot-up process and appears hung... Failure of the **Working** screen to appear on the Operator Panel in 15 minutes indicates that the boot-up process is not completing.	1. Power OFF the library and wait at least one minute before powering ON to recover the problem. 2. If a library firmware update was just performed, try to repeat the update procedure. If the library firmware still fails to boot-up correctly, contact your next level of support.
	Library firmware is being updated...	Additional time is required by the library, including a blank screen then a backlit screen, before the **Working** screen appears.
	All firmware (library and drive) is not at the latest level...	Refer to "Methods of Updating Firmware" on page 6-25 for instructions on updating all of the components which are not at the latest level. The procedure will direct you to the IBM web site to check for latest firmware levels.
Logs	**You are required to capture a library log or a drive log...**	For information on capturing a library or drive log, refer to "Methods of Capturing Logs" on page 6-11
	You need to acquire library or drive information at the host...	Refer to Appendix E, "Message Retrieval at the Host," on page E-1.
Diagnostics	**You need to run library diagnostic tests...**	Refer to "Tools –> Service Menu: System" on page 6-7.
Configuration	**Configuring the library resulted in fewer storage slots than are actually present.**	Verify that the Capacity Expansion license keys have been applied as needed.
	You are reinstalling a feature requiring a License Key code.	1. From the Operator Panel, select **Setup** > **License**. 2. Re-enter the license key code. If the license key code can not be located, contact your IBM Sales Representative.
Power	**If the power supply power switch is ON and power indicator is OFF...**	1. Verify that the power switch is ON. 2. Verify that the power cable is properly seated on the Power Supply. 3. Analyze the problem by observing the Power Supply LEDs (see "Power Supply LEDs" on page 6-22). 4. If necessary, replace the failing power supply (refer to "Power Supply (Primary and Redundant)" on page 7-51).
	If the blue LED on the power supply is ON, the power ON/OFF button on the front of the library is ON (button pushed IN), but the power indicator on the front of the library is OFF...	1. Suspect a failing power ON/OFF push button on the front of the library, or a loose or broken cable. 2. Check and reseat internal cable from the power ON/OFF push button to the back of the Operator Panel to the backplane connect board (BCB). See "Internal Cables" on page 6-33. 3. See "Replacing the Power Switch/LED Board Assembly" on page 7-31.

Problem Area	If...	Then...
Picker	**The Picker is stuck in one position and is making a clicking sound...**	1. Visually verify that all gear racks (front and rear) are properly aligned. If they are not aligned, refer to "Verifying Front and Rear Gear Racks Alignment" on page 7-21. 2. Ensure the Y-axis Assembly is level from front to back. If a gear rack gap was discovered, or if the Y-axis Assembly was previously removed and replaced, one side may be off by one or two teeth. With the top cover removed, and power OFF, slowly lift the Y-axis Assembly and re-insert (see "M2 Robot Assembly" on page 7-77). 3. Check for broken gear teeth on the Y motor. If there are broken teeth, replace the Y-Axis Assembly.
	The Picker Assembly does not move within five minutes after Power ON...	1. Check cable connections from the Cable Spool to the Y-axis Assembly and from the Y-axis Assembly to the Picker. 2. With Access Doors closed, note if the green LED on top of the Picker is ON. • For a 5U library, open the I/O Station door to view. • For a 14U library or larger, look through the expansion module window. 3. If the green LED is OFF, suspect the Picker Assembly, the Y-axis Assembly, the module-to-module communication terminator, or an open door. 4. If the Picker Assembly is still not working, contact your next level of support.
Performance	**If the library is experiencing excessive retries and/or the Y-axis Assembly seems noisy...**	• Ensure both front and rear gear racks on all modules above the bottom-most module on a multiple module unit (such as a 14U library) are in the lock-down position. Gear racks between modules must not have a gap between them; otherwise, the Y-axis Assembly will no longer be level. • Ensure the Y-axis Assembly is level from front to back. If a gear rack gap was discovered, or if the Y-axis Assembly was previously removed and replaced, one side may be off by one or two teeth. With the top cover removed, and power OFF, slowly lift the Y-axis Assembly and re-insert (see "M2 Robot Assembly" on page 7-77). • Ensure that the Y-axis motor is properly inserted in the opening in the base plate .

Problem Area	If...	Then...
Web User Interface	**A Web User Interface Help page is not opening...**	Verify that other help pages are not currently open. If other pages are currently open, close them and try again.
	You are unable to log in to the library from the Web User Interface (Web Browser cannot display the web page)...	One of the library security settings may be disabled. • From the Operator Panel: **Tools** > **Security** . • Ensure that the **Network Interface** and **Remote UI** options are enabled.
	You are unable to configure or use one of the internet traffic control parameters such as: • **ICMP (Internet Control Message Protocol or pinging the library)** • **SSH (Secure Shell) (iLink Services)** • **SNMP (Simple Network Management Protocol)** • **SMI-S (Storage Management Initiative Specification)**	One of the library security settings may be disabled. • From the Operator Panel: **Tools** > **Security** For more information, refer to "Configuring Library Security Settings" in the Operating Procedures chapter of the TS3310 Setup and Operator's Guide.
Library Not Booting	• **There is a blank Operator Panel/display** • **Picker doesn't move** • **Display is stuck on IBM or initialization for more than 20 minutes** • **Lights are not correct on back of library.**	Suspect the LCB compact flash or the power supply.

Chapter 2. Product Description

"Front Panel Components" on page 2-2

"Rear Panel Components" on page 2-5

"Interior Components" on page 2-7

"Optional Features" on page 2-14

"Location Coordinates" on page 2-28

"Data Cartridges" on page 2-31

"Multi-Path Architecture" on page 2-33

"Specifications" on page 2-36

"Product Environment" on page 2-37

"Supported Servers, Operating Systems, and Software" on page 2-38

"Supported Device Drivers" on page 2-38

The IBM System Storage™ TS3310 Tape Library offers high performance, capacity, and technology designed for reliability and the heavy demands of tape storage. The Ultrium 5 cartridge has a native data capacity of 1500 GB (3000 GB at 2:1 compression). This library is highly modular with scalability varying from the base library 5U control module with up to four additional expansion units for a total of 41U height. This automated tape library incorporates high-performance IBM LTO Ultrium Tape Drives for the midrange to enterprise open systems environment. The Ultrium 4 cartridge has a native data capacity of 800 GB (1600 GB at 2:1 compression). IBM LTO Ultrium 4 tape drives can read and write original LTO Ultrium 3 data cartridges and read LTO Ultrium 2 data cartridges. The Ultrium 3 cartridge has a native data capacity of 400 GB (800 GB at 2:1 compression). IBM LTO Ultrium 3 tape drives can read and write original LTO Ultrium 2 data cartridges and read LTO Ultrium 1 data cartridges.

The base TS3310 library contains the library control module, fixed tape cartridge storage of 30 slots, I/O station of 6 slots, a touch screen display, cartridge handling robotics, and up to two LTO Ultrium tape drives.

You can add up to 4 optional expansion modules to a control module.

Note: Rack doors are required for any library that has more than 14 drives installed.

Each 9U expansion module can accommodate up to 4 LTO Ultrium Tape Drives and up to 92 tape cartridge slots including 12 configurable I/O station slots.

This library supports LTO Ultrium 5 native switched fabric Fibre Channel attachment, and LTO Ultrium 4 Tape Drives with either Serial Attached SCSI (SAS) or native switched fabric Fibre Channel attachment for connection to a wide spectrum of open system servers. This library also supports LTO Ultrium 5 native switched fabric Fibre Channel attachment. It also supports LTO Ultrium 3 Tape Drives with either LVD Ultra160 SCSI or native switched fabric Fibre Channel attachment.

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The TS3310 library supports Application Managed Encryption (AME), System Managed Encryption (SME), and Library Managed Encryption (LME) on Ultrium 4 SAS (Serial Attached SCSI) and Fibre Channel (FC) drives using Ultrium 4 media. The AME function is standard on all libraries, while the SME and LME features require a license key.

Front Panel Components

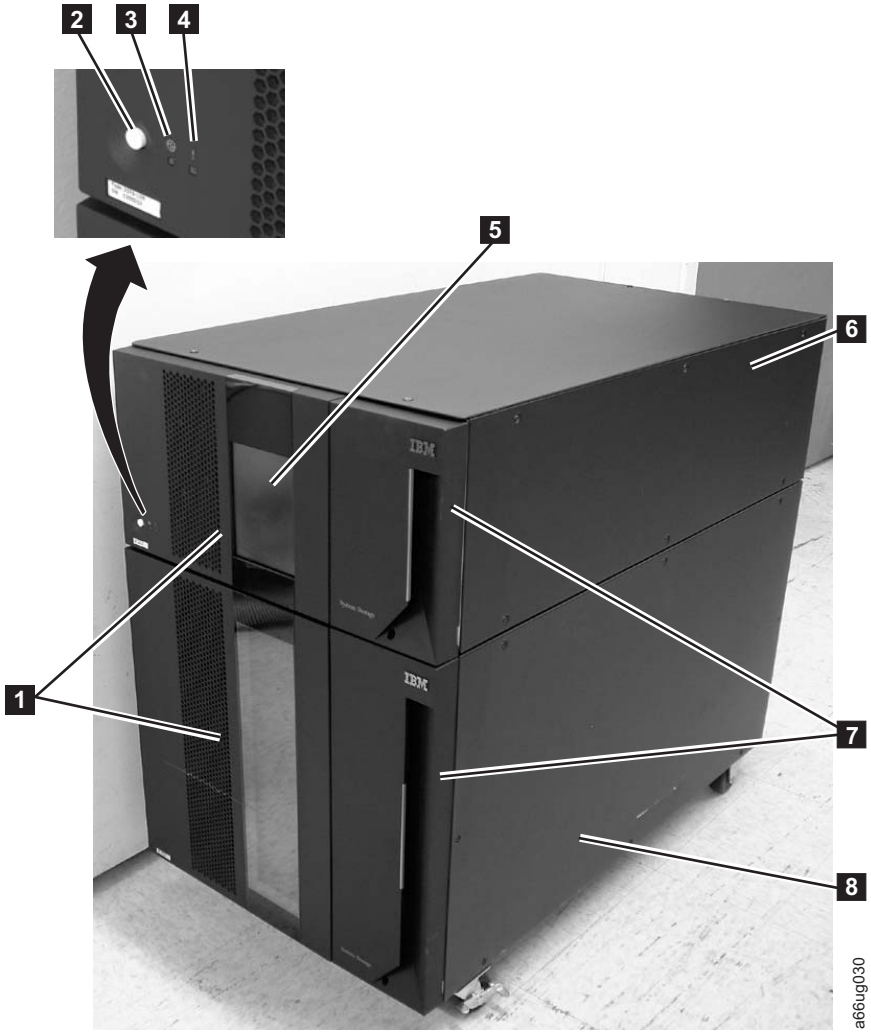


Figure 2-1. Front panel of a 14U library

1	Access doors	5	Operator Panel
2	Power button	6	5U control module
3	Green power ON LED	7	I/O Stations
4	Amber Operator Intervention Alert LED	8	9U expansion module

Control Module (3576 Model L5B)

All library configurations include the control module (6 in Figure 2-1 on page 2-2). The control module contains the robotics, library control blade (LCB), and touch screen display. The control module also contains an I/O station, fixed storage slots, tape drives, and at least one power supply.

The control module can contain one or two tape drives and one or two power supplies. At least one power supply is always required.

Expansion Module (3576 Model E9U)

Each 9U expansion module (8 in Figure 2-1 on page 2-2) is a supplementary module that is attached to the 5U Control Module. Like the control module, the expansion modules provide fixed storage slots, tape drive slots, and power supply slots. The I/O station in an expansion module can be configured as storage.

If an expansion module contains only cartridges (no drives), all power is derived from the control module.

I/O Station

I/O Stations (7 in Figure 2-1 on page 2-2) are located on the front panel of the library and enable the importing and exporting of cartridges without interrupting normal library operations. A control module I/O Station has a capacity of six cartridges. A 9U expansion module I/O Station has a capacity of 12 cartridges.

Note:
This library reads bar code labels to identify the specific cartridges in each slot. Ensure that all cartridges placed in the library have appropriate bar code labels.

When an I/O Station slot is assigned to a logical library, only that logical library can access that slot. The I/O Station is shared among all logical libraries, but the I/O Station slots are owned by one logical library at a time.

In a 5U library, the six I/O Station slots cannot be configured as storage. In a library that has expansion modules, the I/O Stations can be configured as follows:

Table 2-1. Library I/O Station configurations

Number of Expansion Modules	Number of License Keys	I/O slots in expansion modules	I/O slots in control module	Total number of I/O Station Slots
0	0	0	6	6
1	0	12	0	12
1	1	12	6	18
2	1	24	0	24
2	2	24	6	30
3	2	36	0	36
3	3	36	6	42
4	3	48	0	48
4	4	48	6	54

Note: I/O slots can be reassigned each time the I/O Station is opened by rearranging the order of the cartridges in the I/O Station.

Access Door

Each control module and expansion module has a door on the front panel that allows access to the internal components of the library.

This door is locked by the I/O Station. To open the Access Door (1 in "Front Panel Components" on page 2-2), you must first open the I/O Station.

If you want to restrict access to the library, lock the I/O Station door. To do this:

From the Operator Panel: **Operations** > **Lock I/O Station** > **Lock/Unlock**

From the Web User Interface: **Manage Cartridges** > **Lock/Unlock I/O Station Doors**

Attention: When any Access Door is opened, all in-progress motion commands stop, the Picker lowers to the bottom of the library, and the library is taken offline. When this happens, the library must be put back online manually. (see "Taking the Library Online" on page 6-39). When the Access Door is closed, the library returns any media in the Picker to its original storage slot.

Operator Panel

The Operator Panel (5 in Figure 2-1 on page 2-2) is the touchscreen display device located on the Access Door of the control module. Library operations and service functions are performed from this screen.

The Web User Interface offers some of the same functionality as the Operator Panel via a web browser which enables remote access to the library. For more information on the Operator Panel and the Web User Interface, see Chapter 4, "User Interfaces," on page 4-1.

Power Button

Pressing the Power Button (2 in Figure 2-1 on page 2-2) on the front panel of a control module turns the Picker and Operator Panel ON or OFF; however, power is still applied to the power supplies. The Power Button is used during library shutdown and to manually reboot the library.

Front Panel LEDs

Two LEDs are located on the front of the library to the right of the Power Button.

- Green power ON LED (3 in Figure 2-1 on page 2-2): When lit, this LED indicates that the library power is ON.
- Amber Operator Intervention Alert LED (4 in Figure 2-1 on page 2-2): When lit, this LED indicates that there is a Library, Drives, or Media Operator Intervention available. To access the Operator Intervention, select **Tools** > **Operator Intervention** from the Operator Panel.

Rear Panel Components

The following components are located on the rear panel of the library:

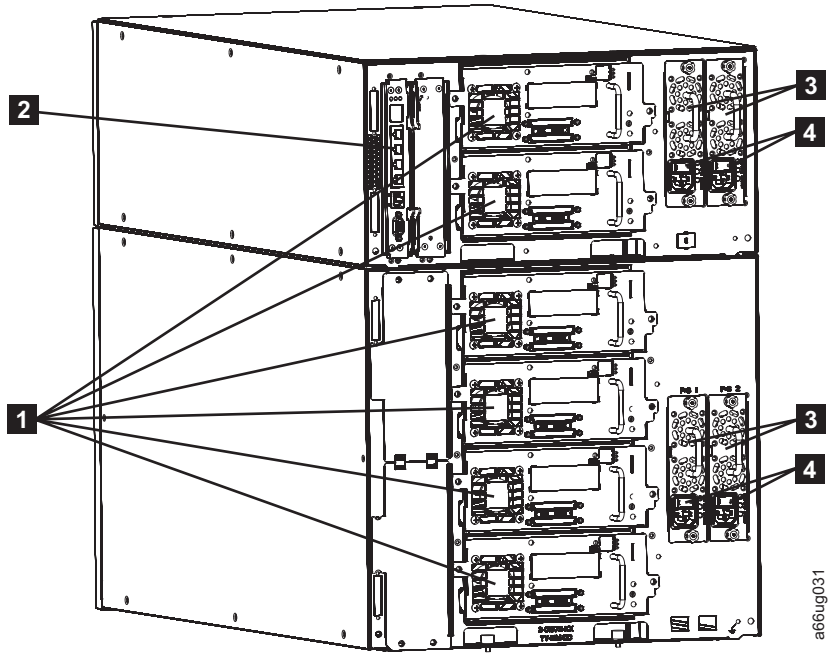


Figure 2-2. Rear panel of a 14U library

1	Tape drives (SCSI drives shown)	3	Power supplies (2 in control module; 2 in expansion module)
2	Library Control Blade	4	Power supply switches

Library Control Blade (LCB)

The Library Control Blade (2 in Figure 2-2) manages the entire library, including the Operator Panel and Picker, and is responsible for running system tests to ensure that the library is functioning properly.

The LCB houses the Compact Flash Card which stores vital product data (VPD) such as library settings, serial number, etc.

The LCB indicates status with three light emitting diodes (LEDs). These LEDs, located near the top of the LCB, are green, amber, and blue in color.

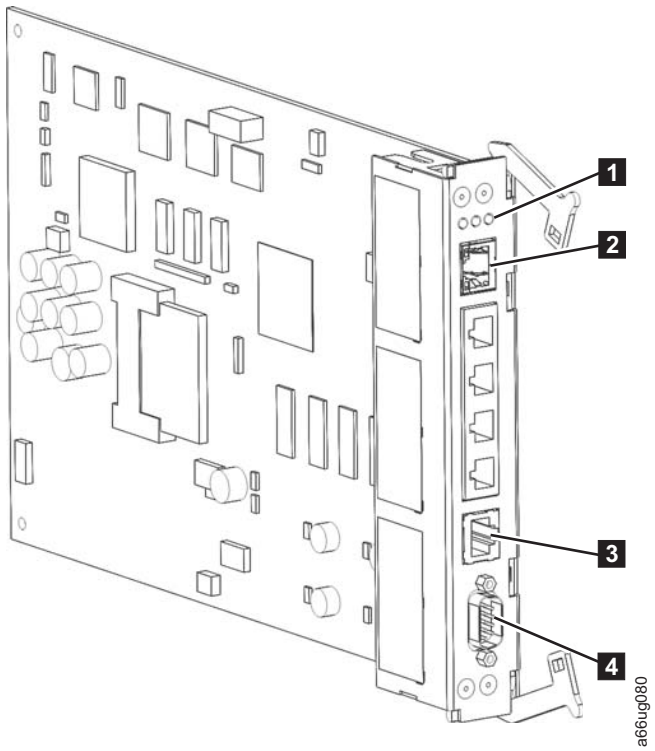


Figure 2-3. The library control blade

1. LEDs
   - Green indicates a good status.
   - Amber indicates a degraded status.
   - Blue indicates a potential fault. See “Interpreting LEDs” on page 6-17.
2. Gigabit Ethernet (external network) port
3. Service Ethernet port (10/100 Mb/s)
4. Service serial port

Tape Drives

The library supports Ultrium160 SCSI, Serial Attached SCSI (SAS), and Fibre Channel tape drives.

Tape drives (**1** in Figure 2-2 on page 2-5) are hot addable (library power remains ON and operations of the installed tape drives are still active). Drives can be removed and installed without tools.

Ultrium160 SCSI tape drives are attached directly to a host. Fibre Channel tape drives can be directly attached to a host or a Storage Area Network (SAN). Each SAS link is point-to-point so a maximum of 2 hosts could share a dual-port SAS tape drive.

Drives mounted in sleds are installed into tape drive slots in the rear of the library. If a tape drive slot is empty, a metal plate covers the empty drive slot. This "metal plate" cover has a connector that plugs into the drive connector, providing electrical termination for some of the drive circuits. It also serves as a safety cover, and prevents debris from entering the library. All empty drive slots must have one of these covers installed for proper library operation.

Power Supply

The library supports single and redundant power configurations. Each control module must have at least one power supply. A single power configuration will have a power supply installed in the left slot of each library module as viewed from the rear. A redundant power configuration will have power supplies installed in both slots of each library module.

The single configuration has a single AC line input and a single DC power supply. The optional redundant configuration has dual AC line input and dual DC power supplies. A power supply (**3** in Figure 2-2 on page 2-5) can be hot swapped if the library has a redundant power supply. A redundant power supply can be hot added.

A power switch (**4** in Figure 2-2 on page 2-5) is located on every power supply. This switch is used to remove all power from the library for emergency and service situations. Except in emergency situations, use the shutdown procedure before switching OFF the power switch. For more information, see "Shutting Down the Library" on page 6-40.

The power system of the library contains the following components:

- Power supply
- AC power cord

The power supply has three light emitting diodes (LEDs) that provide status information. These LEDs, located to the right of the power switch, are green, amber, and blue in color.

- Green indicates a good AC or DC status.
- Amber indicates a degraded status.
- Blue indicates a potential fault. See "Interpreting LEDs" on page 6-17.

Interior Components

The following components are located inside the library:

- "Storage Columns" on page 2-8
- "Robot Assembly Designs" on page 2-8

Storage Columns

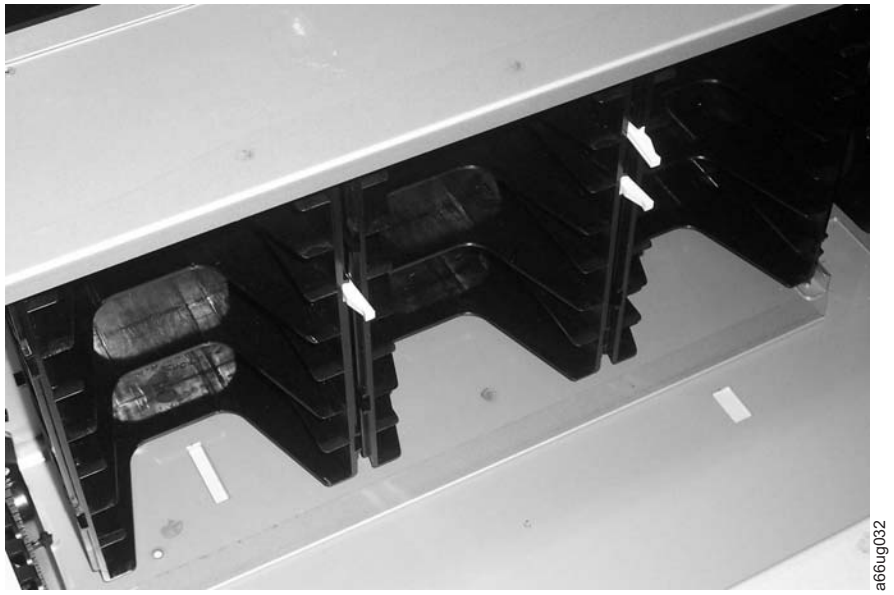


Figure 2-4. Storage columns

Storage columns within the library store cartridges while they are not being utilized by a drive. The library contains six storage columns. One of those six columns is the I/O Station.

Robot Assembly Designs

The Picker (robotic arm) has fingers that enable it to grab tape cartridges and move them to and from the I/O Station, storage slots, and drives. A Bar Code Scanner located inside the Picker, reads each cartridge bar code label and the fiducial labels that identify the types of cartridge magazines and tape drives installed in the library.

As of November 2008, the robot assembly was changed. The two robots are identified as follows:

- Pre-November 2008 - The robot will be referred to as the "Model 1 robot" and the components as the "Model 1 picker" and the "Model 1 Y-carriage assembly."
- November 2008 and forward - The robot will be referred to as the "Model 2 robot" and the components as the "Model 2 picker," the "Model 2 Y-carriage assembly," and the "Model 2 robot controller board."

520G is the minimum version of library firmware that supports the Model 2 robot. The Model 2 robot allows access to five additional slots in the library (the second-from-bottom row of slots are now available; the Model 1 robot could not reach them). However, although Model 2 robot assemblies will "fit" onto libraries that were built with the Model 1 robot, IBM does not support switching them out. Robot versions must not be changed in the field. If a customer has an Model 1 robot, you must replace it with a Model 1 robot or components. Similarly, if a customer has a Model 2 robot, you must replace it with a Model 2 robot or components.

How to Determine Which Robot Your Library Contains

Physical Indicators

- Model 2 robot label. Model 2 robots have an “M2” label located on the front of the Y-carriage assembly, visible from outside the library.
- Physical appearance. The Model 2 robot has a large PCB (called the robot controller board) on the Y-carriage assembly. It also looks different. For pictures, see “M2 Robot Assembly” on page 2-12).

Software Indicators

- Operator panel Tools > About Library screen: Libraries containing a Model 2 robot have a line item called "Robot FW." Libraries containing Model 1 robots do not have this line item.
- Web client Service Library > View/Update Library Firmware Level screen: Libraries containing a Model 2 robot show a listing for "Robot Firmware Version" in the Physical Library section of the page. Libraries containing Model 1 robots do not have this listing.
- Snapshot/log files: The “Robot Firmware” entry noted above is contained in snapshots, logs, etc. for libraries containing Model 2 robots. Libraries with Model 1 robots do not have the "robot firmware" entry.

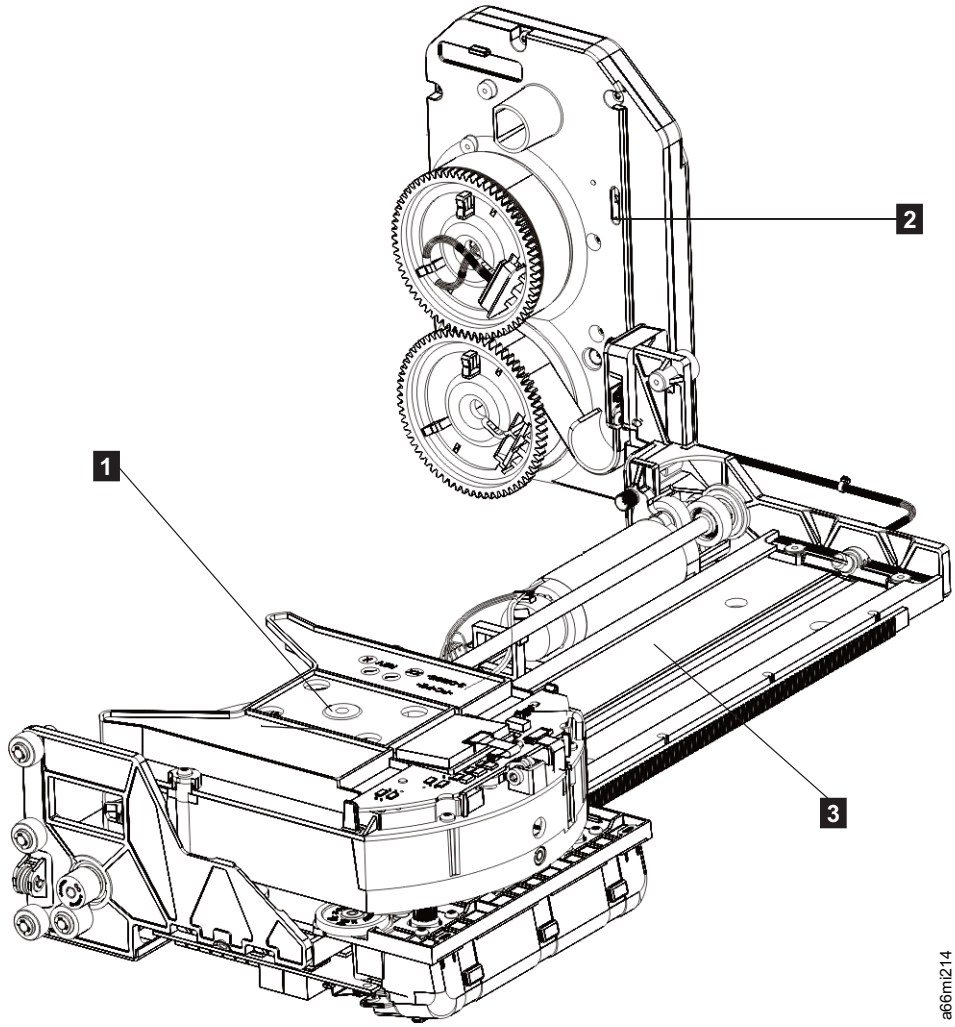


Figure 2-5. Model 1 Robot Assembly with Original Cable Spool

1 Picker

2 Cable Spool

3 Y-carriage assembly

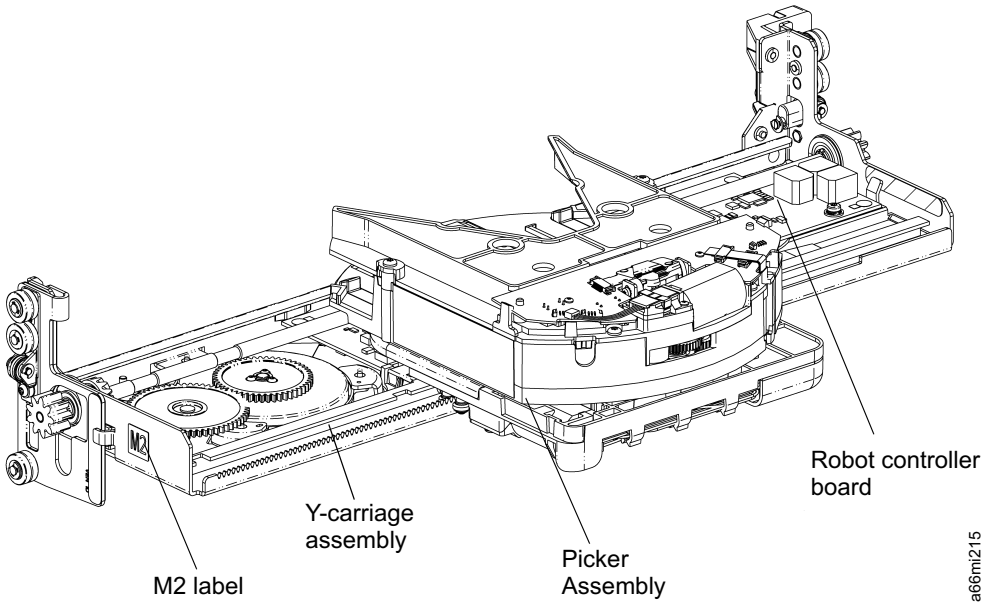


Figure 2-6. Model 2 Robot Assembly (Picker Assembly and Y-carriage Assembly)

The Robot Assembly has two designs, referred to as **Robot Assembly** and **M2 Robot Assembly**. The differences are explained in this section.

Robot Assembly

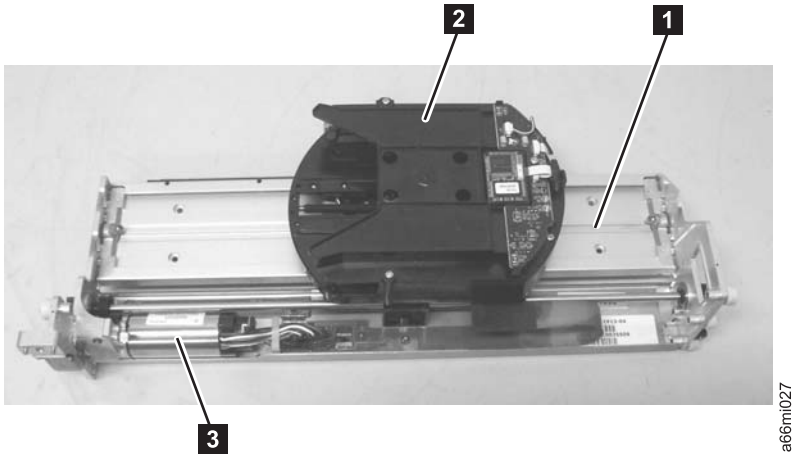


Figure 2-7. Robot Assembly

The Robot Assembly design displays the Y-Axis Assembly housing the Y Motor (**3**), and the Picker Assembly (**2** which is attached to the Carrier (**1**). The Climber moves the Y-Axis/Picker Assembly within the library.

M2 Robot Assembly

While serving the same function as that of the Robot Assembly, the M2 Robot Assembly has a different design style which is depicted in the following images.

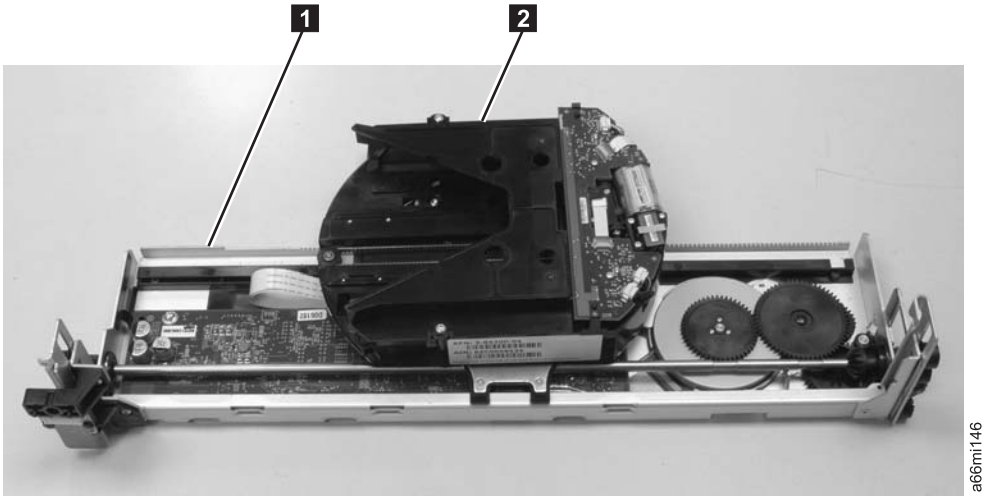


Figure 2-8. M2 Robot Assembly

In the M2 Robot Assembly, the Robot Assembly houses the Y-Axis controller board (**1**) and the M2 Picker Assembly (**2**) is attached to the Carrier.

The M2 label is clearly visible on the side of the Robot Assembly which faces the door of the library. See Figure 2-9.

Figure 2-9. M2 Label on the M2 Robot Assembly

Optional Features

The table below lists additional features that can be added to the library to enhance performance.

Table 2-2. Optional features

Type of Feature	Description	Feature Code
Ultrium 5 Tape Drive	8 Gb Fibre Channel interface	8242
Ultrium 4 Tape Drive	3 Gb SAS interface	8139
	4 Gb Fibre Channel interface	8142
Ultrium 3 Tape Drive	Ultra160 SCSI interface	8037
	4 Gb Fibre Channel interface	8042
Power Supply	Redundant	1900
Feature Licenses	Capacity Expansion	1640
	Advanced Reporting	1650
	Path Failover	1682
	Transparent LTO encryption	5900
Library and Drive Code Update	Library and drive code update by an IBM Service Representative	0500
Rack Mount Kit	Hardware required to mount your library in a rack	7003
Rack PDU Line Cord	Rack PDU line cord	9848

For information on ordering additional features or replacement parts for your library, see Chapter 9, “Parts List,” on page 9-1.

Ultrium Tape Drives

This library supports the Ultrium 3, Ultrium 4, and Ultrium 5 Tape Drives. Each tape drive in the library is packaged in a container called a drive sled. The drive sled is a customer replaceable unit (CRU), and is designed for quick removal and replacement in the library.

The IBM Ultrium 5 Tape Drive supports the Fibre Channel interface. The IBM Ultrium 4 Tape Drive supports SAS or Fibre Channel interfaces. The IBM Ultrium 3 Tape Drive supports LVD Ultra160 or Fibre Channel interfaces. Depending on which drive is installed, it features two HD68 SCSI connectors, two SAS SFF-8088 connectors, or one LC Fibre Channel connector.

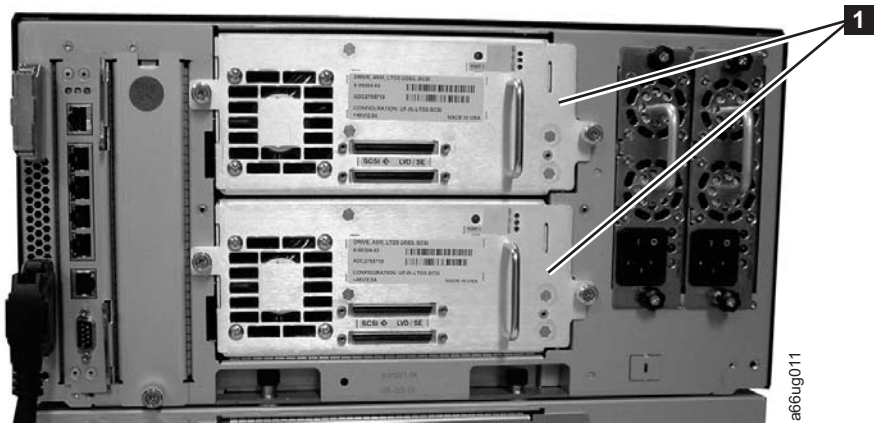


Figure 2-10. Ultra160 SCSI Tape Drives in the library control module

Note: Ultra160 SCSI, SAS, and Fibre Channel drives are allowed in the same physical and logical libraries. However, you should ensure that the host application will support a mix of interface drive types.

LTO-5 Tape Drive Ports

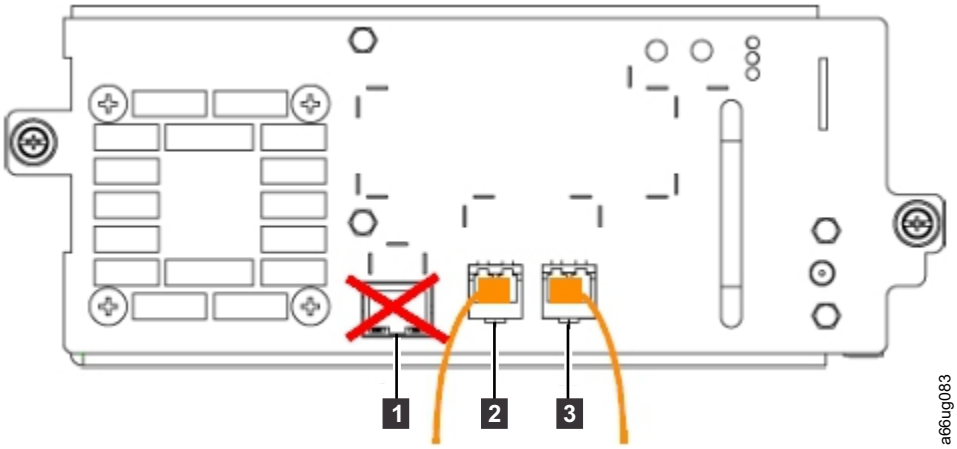


Figure 2-11. LTO-5 Tape Drive Ports

Table 2-3. LTO-5 Tape Drive Ports

1	Ethernet port	do not use
2	Fibre Channel port 1	default data port
3	Fibre Channel port 2	default failover port

Speed Matching

To improve system performance, this tape drive uses a technique called *speed matching* to dynamically adjust its native (uncompressed) data rate to the slower data rate of the attached server.

Channel Calibration

The channel calibration feature of the Ultrium drives customizes each read/write data channel for optimum performance. The customization enables compensation for variations in the recording channel transfer function, media characteristics, and read/write head characteristics.

Power Management

The power management function controls the drive's electronics so that part of the electronics completely turn OFF when circuit functions are not needed for the drive's operation.

Redundant Power Supply (Feature Code 1900)

The optional redundant configuration power supplies may be hot swapped without interrupting library operation. Each supply in a control module and expansion module includes its own input AC line cord. During redundant operation, each supply carries one-half the power load. If a line cord or power supply fails, the second supply sources the complete power load. Optionally, a single power supply and line cord may be installed if redundant power is not required. The second power supply slot is physically covered in this configuration. The library may be upgraded to redundant power at a later time.

Feature Licenses

A feature license controls the setting of feature-enabled flags that are based on a user input key and the library serial number that is stored in the library vital product data (VPD). A unique key exists for each library based on an encryption of the chassis serial number and a feature code.

After a feature is enabled, it cannot be disabled. The library's serial number can only be assigned at the factory.

The library uses feature licenses to enable the Capacity Expansion, Advanced Reporting, Path Failover, and Transparent LTO Encryption features.

Advanced Reporting (Feature Code 1650)

The Advanced Reporting feature license key enables the Media Analysis and Drive Resource functions of the TS3310 Tape library. These user-configurable reporting features provide graphical displays for both diagnostic and trend analysis data which enable customers to evaluate tape drive, media performance, and drive utilization parameters.

Advanced Reporting is only available to Superuser, Administrative and Service users through the Web User Interface (UI). Data for Advanced Reporting should persist for 12 months, but it is also limited to 1 MB. The persisted data is checksum protected and will persist through a library power loss. The raw data for these reports can also be downloaded and e-mailed as a Comma-Separated Values (.csv) file through the remote Web UI.

Advanced Reporting Reports:

You use the Advanced Reporting function to create reports that can be configured for viewing and analysis.

Note: To use Advanced Reporting, you must have Advanced Reporting licensed on your library and your library firmware must be at version 520G or later. The Advanced Reporting license applies to your entire library, regardless of

library size. Therefore, you only need to purchase the license once. If you increase the size of your library, your existing license applies to your new library configuration.

Drive Utilization
Drive Utilitzation provides tape drive usage information that shows which tape drives are working at optimum capacity and which are under-utilized. This information can help you allocate tape drive resources properly.

Media Integrity
Media Integrity provides TapeAlert counts for various combinations of tape drives, tape cartridges, and TapeAlert flags. This information can help you determine if a problem is due to a specific tape drive or tape cartridge.

Media Security
Media Security enables you to be notified if media is removed from the library without the administrators' knowledge or without direction from the backup application.

Details about using Advanced Reporting include:

- The data for these reports is collected in log files that are located under the Service Library menu tree on the IBM UI. When the log files reach their maximum size, the oldest information is deleted as new information is added. This can affect how much historical data you can access.
- The on-screen report contains a chart and a data table. When the log files are large, it can take a long time to load all the historical data into the data table. Therefore, the table only contains data for the previous seven days, even if you select a range longer than seven days. The graph, however, displays information for the entire range. To view all of the data, you must save or email the data file. For more information on saving and emailing the data file, see "Saving and Emailing Advanced Reporting Reports and Logs" on page 2-22.
- The reports are built according to data in the log files, not data in the current library configuration. Therefore, your library may contain tape drives or cartridges that do not show up in the report. Similarly, the report may contain tape drives and cartridges that no longer reside in the library.
- Information about a tape drive, cartridge, or operation is not recorded in the Drive Utilization log file until after a tape cartridge has been mounted (loaded) and unmounted (unloaded) from the tape drive.

Drive Utilization Reporting:

The Drive Utilization function records drive, read, and write history which can be used to identify drives or groups of drives that are nearing 100% utilization. It also identifies drive resources that are not being fully utilized. These reports provide the customer with information necessary to determine if, and when, additional drives are necessary.

Data collected and saved for these reports include the following:

- Drive location (module, row)
- Drive serial number
- Logical library
- Megabytes read

- Megabytes written
- Time and date of mount (in GMT)
- Time and date of dismount (in GMT)
- Media motion time (in seconds)
- Media barcode

You can only access this report from the web client. The path to open the report is **Monitor System** > **Advanced Reporting** > **Drive Utilization**.

To configure the report, select the radio button beside the appropriate settings:

- Range — Specifies the range of time covered in the report
  - Last seven days
  - Last four weeks (default)
  - Last three months
  - All history (as far back as there is data in the log file)
- Attribute — Specifies which values are included in the report. Select one of the following:
  - Data Written/Read (default): the amount of data written to and read from each tape drive, shown separately in the chart
  - Total Read and Write: the combined total amount of data written to and read from each tape drive
  - Mount Count: the number of tape cartridge mounts
  - Media Mount Time: the total amount of time media spent in the selected drive or drives
  - Media Motion Time: the total amount of time media spent in motion while in the tape drive (writing, reading, rewinding, etc.)
- Chart — Indicates how the data is displayed in the chart. Select Area, Bar (default), Line, or Pie
- Type — Indicates the chart type. Select one of the following:
  - Rollup (default) — Displays the grouping on the x-axis and the attribute amount on the y-axis
  - Trend — Shows how the attribute amount changes over time for the selected grouping
- Grouping — Specifies which one or more tape drives or partitions are included in the report. Select one of the following:
  - All drives by coordinate (default): Presents the sum total of the selected attributes for all tape drives according to their location in the library. If more than one tape drive resided in that location during the selected range, then the attribute values for all the tape drives that resided in that location are combined in the chart
  - All drives by physical serial number
  - All partitions: Presents the sum total of the selected attribute for all drives according to the physical tape drive serial number
  - Selected drive by coordinate: The report chart is based on an individual tape drive location in the library. If more than one tape drive resided in that location during the selected range, then the attribute values for all the tape drives that resided in that location are combined in the chart
  - Selected drive by physical serial number: The report chart is based on an individual tape drive identified by its physical drive serial number

– Selected partition: The report chart is based on an individual partition in the physical library

Media Integrity Reporting:

The Media Integrity function records TapeAlert events to measure and evaluate media and drive performance in the library. The administrator can request, or configure various reports to assist in managing the overall reliability and performance of the media and drives, or both.

Data collected and saved for these reports include the following:

- Media barcode
- Drive serial number
- TapeAlert value
- Occurrence count of TapeAlert
- Time and date of last TapeAlert occurrence (in GMT)

You can only access this report from the web client. The path to open the report is **Monitor System** > **Advanced Reporting** > **Media Integrity**.

To configure the report, select the radio button beside the appropriate settings:

- Range — Specifies the range of time covered in the report
  - Last seven days
  - Last four weeks (default)
  - Last three months
  - All history (as far back as there is data in the log file)
- Attributes — Specifies which values are included in the report, and how they are combined. Select in any combination, including all (default) and none. If you select no attributes, the chart displays the TapeAlert count for the selected Grouping.
  - Cartridge Barcode — All relevant tape cartridges
  - Drive Physical Serial Number (SN) — All relevant tape drives
  - TapeAlert — The TapeAlert flags that were issued. For a description of all TapeAlert flags, see Chapter 5, “Service Action Tickets (Txxx) and Diagnostic Resolutions (DRxxx),” on page 5-1.
- Chart — Indicates how the data is displayed in the chart. Select Area, Bar (default), Line, or Pie
- Type — Indicates the chart type. Select one of the following:
  - Rollup (default) — Displays the number of TapeAlerts for the combination of Grouping and Attributes you selected (default)
  - Trend — Shows the occurrence of TapeAlerts over time
- Grouping — Specifies which one or more drives or tape cartridges on which to base the report. Choose one of the following:
  - All (default) — All tape drives and tape cartridges for which a TapeAlert was issued during the specified range
  - Selected Drive by Physical Serial Number — An individual tape drive. Only tape drives which issued a TapeAlert during the specified range appear in the report.
  - Selected Cartridge by Barcode — An individual tape cartridge. Only tape cartridges that were associated with a TapeAlert during the specified range appear in the report.

- Sorting — Specifies how the data will be sorted. Choose from the following:
  - Alphabetical
  - Count (ascending)
  - Last Occurrence (default)

Media Security:

Media Security is a feature of the library that enables you to be notified if media is removed from the library without the administrators' knowledge or without direction from the backup application.

Note: Unexpected removal refers to tape cartridges that were removed from the library without being properly removed via the I/O station. Expected removal refers to tape cartridges that were removed properly via the I/O station.

The library detects media removal when it performs an inventory (at boot up; after an open door is closed, etc.) For example, if someone opens the front door of the library and takes a piece of media, the library can notify the administrator which tape was taken, when it was taken, and in what fashion.

You can enable the library to collect information about media removal, and then do any or all of the following; view, save, or email the log.

Note: This feature is only available if the Advanced Reporting license is installed on the library.

To configure what information gets tracked in the log, select **Monitor System** > **Advanced Reporting** > **Media Security** from the remote user interface.

You can configure the library to collect any or all of the following information. By default, the library collects nothing and the log is empty. You must select each item you want the library to collect.

- Unexpected removal detection after power-up and reboot only
- Unexpected removal detection during library operation
- Expected removal detection from I/E slots during library operation

The log file contains the following information:

- Date and time of media removal
- Tape cartridge barcode
- Type of removal (expected or unexpected)
- Slot location coordinates (of the slot from which the tape cartridge is missing)
- Slot type (IE, storage, or cleaning)

The log only lists media that have been completely removed from the library. It does not list media that move from one location to another within the library. When the log file reaches its maximum size, the oldest information is deleted as new information is added. This can affect how much historical data you can access.

To view, save, or email the report, select **Service Library** > **Media Security Log** from the remote user interface. Click **Select Action**, select **Download** or **Email** options, then click **Go**.

Media Usage:

The Media usage report lists information regarding data written and read on the media and lists statistics pertaining to soft and hard read and write errors. The media usage log collects information on all media that have ever been in the library, including media that are no longer in the library. Lifetime media usage metrics are associated with the cartridge and are kept on the embedded cartridge memory.

To view the media usage log, go to **Service Library** > **Media Usage Log**.

The log reflects what the drive reports from the embedded cartridge memory whenever the media is unloaded. If the tape cartridge was never mounted and unloaded, it will not appear in the log. When the log file reaches its maximum size, old information is deleted as new information is added. This can affect the amount of available historical data.

The log provides the following information:

- Volser — Media cartridge barcode label
- SN — Media cartridge serial number
- Mfr — Media cartridge manufacturer
- Date — Media cartridge manufacturing date (format: YYYYMMDD)
- Type — Media type
- Mounts — Cartridge mount count
- RRE — Recovered read errors
- URE — Unrecovered read errors
- RWE — Recovered write errors
- UWE — Unrecovered write errors
- LW — Cartridge lifetime MB written
- LR — Cartridge lifetime MB read
- Enc — Cartridge encryption status (U=Unknown, E=Encrypted, N=Not Encrypted

Using Advanced Reporting Templates:

If you want to use the same configuration to create reports repeatedly, you can save the configuration as a template. You can save up to 20 templates for each type of advanced report.

To create a template:

1. From the remote UI, go to **Monitor System** > **Advanced Reporting** and select the Advanced Reporting Configuration page, either Drive Utilization or Media Integrity.
2. On the Advanced Reporting Configuration page, make the selections you want.
3. Type a name for the template in the empty field next to the **Save** button. The name can have a maximum of 15 characters. You can use only lowercase letters, numbers, and the underscore character (_) in template names.
4. Click **Save**.

The report appears in the drop-down list in the **Report Templates** box.

To use a saved template, select the template from the drop-down list in the **Report Templates** box. and click **Load**.

To delete a template, select the template from the drop-down list in the **Report Templates** box.and click **Delete**.

Advanced Report Configuration:

To perform Advanced Report Configuration, from the remote UI, go to **Monitor System** > **Advanced Reporting** and select the Advanced Reporting Configuration page, either Drive Utilization or Media Integrity. When you first open the Advanced Reporting Configuration page, the system loads all the data from the library log file for that report to the Internet browser in preparation for creating your reports. If there is a lot of information in the log files, this can take several minutes.

The data that is loaded in the Internet browser remains unchanged until you log out of your library session or reload the data. If new data is added to the library log file during your session (for instance, a TapeAlert occurs), it does not appear in the onscreen report until you either log out of the library and log on again, or reload the data.

To reload the data without logging out, click **Reload** at the bottom of the Advanced Reporting Configuration page. The entire data set reloads, which can take several minutes.

Look at the Report Data section of the Advanced Reporting Configuration page to see how many records were loaded from the log files for this report. A note states the number of records that were read.

Deleting Advanced Reporting Data:

You can delete the information that is contained in the log files that are used to build the advanced reports.

Attention: After you delete the data in the log files, you cannot restore it. The **Reload** button does NOT retrieve deleted data. Save all the data for both the Drive Utilization report and the Media Integrity report before you delete the data from the library. For more information on saving your data, see "Saving and Emailing Advanced Reporting Reports and Logs."

From the remote UI, go to **Monitor System** > **Advanced Reporting** and select the Advanced Reporting Configuration page, either Drive Utilization or Media Integrity.

To delete the Advanced Reporting data, click **Delete** in the Report Data section of either Advanced Reporting Configuration page. This deletes the data for both the Drive Utilization report and the Media Integrity report.

Saving and Emailing Advanced Reporting Reports and Logs:

You cannot save a report as it appears on the screen, but you can save or email report data as a comma-separated values (.csv) file. You can then import the .csv data into a spreadsheet program and manipulate it to create your own reports for analysis. The .csv file contains all of the data that is in the log file that falls within the date range you specify.

Note: Administrators can configure the library email account and email notifications. Users with user or superuser privileges can receive email notifications, but they cannot configure the library email account or email notifications.

You can configure the library to automatically email Advanced Reporting logs and reports to specified recipients on a daily or weekly basis. You can create up to 20 email recipients. If you want to send the same recipient a different set of reports, you can enter the same email address more than once, with different reports selected for each. Each entry counts as a unique recipient toward the 20 total.

Note: Duplicate entries are not allowed. A duplicate entry means the same recipient is set to receive the exact same reports in two different entries, regardless of the day or time. If you have duplicate recipients, make sure that the reports selected in each entry are not an exact match.

If you have one entry in which Recipient A receives the Drive Utilization and Media Integrity reports on Monday, you cannot create another entry to send Recipient A the Drive Utilization and Media Integrity reports on Thursday. Instead, you can create one entry for Recipient A and send the reports every day (select Daily as the day to send the report), or you can change the reports you are sending so that they are not the same as the first entry. You could create three entries for Recipient A as follows: 1) send both reports out on Monday; 2) send Drive Utilization out on Thursday; and 3) send Media Integrity out on Thursday (in a different entry). The recipient is the same, but the reports sent in each entry are different.

Before the library can send email notifications, you must configure the library email account.

From the remote UI, select **Manage Library** > **Settings** > **Email Notifications**. Click **Select Action**, select an action, and click **Go**.

You can modify the settings of an existing email notification at any time after it is created. If an email notification is no longer needed, you can delete it.

To save or email data:

1. From the remote UI, go to **Monitor System** > **Advanced Reporting** and select either Drive Utilization or Media Integrity to generate a report.

   For more information on generating a report, see "Advanced Reporting Reports" on page 2-16
2. Click **Display Report** at the bottom of the page to display the report viewing screen.
3. Scroll down to the bottom of the report viewing screen to the **Retrieve the Report Data File** box.
4. Do one of the following actions:
   a. To save the report data as a .csv file, click **Save**.
   b. To email the report data as a .csv file, type the name of a recipient in the empty field next to the **Email** button, then click **Email**.

Each email notification includes an optional comment text box that you can use to enter information for the recipient about the library, reports, and logs. This information appears in the body of the email.

Capacity Expansion (Feature Code 1640)

At any time, the Capacity Expansion feature (Feature Code 1640) allows you to enable the unused storage slots within a library via a firmware license key.

The TS3310 Tape Library Model L5B control module includes license key enablement for 82 total cartridges, thus enabling all cartridge slots in the control module and approximately one half the capacity of an added expansion module. To enable the remaining cartridge storage slots, you must purchase Capacity Expansion feature #1640 for each expansion module you want to fully enable. For example, one Capacity Expansion feature #1640 would be required to totally access and enable all available cartridge slots in a 14U configured library (one control module and one expansion module). Two Capacity Expansion features #1640 would be required to totally access and enable all available cartridge slots in a 23U configured library (one control module and two expansion modules).

To see your library's current configuration:

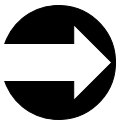
- From the Operator Panel: view the **Capacity View** home icon.
- From the Web User Interface: **Monitor System** > **System Summary**

To enter a Capacity Expansion license key:

From the Operator Panel: **Setup** > **License**

From the Web User Interface: **Manage Library** > **Settings** > **Feature Licenses**

When the license key is entered, the total number of available slots in the library increases. To verify that the number of slots did increase:



- From the Operator Panel, view the Capacity View home screen.
- From the Web User Interface: **Monitor System** > **System Summary**

Table 2-4. Licensable cartridge slots (storage and I/O) per model

Library Configuration	Number of Available I/O Station Slots*	Number of Accessible Storage Slots	Total Slots**	Capacity Expansion License Keys
5U library (control module)	6	30	36	no license key required
14U library (control module + 9U expansion module)	6/12/18	76/70/ 64	82	no license key
	6/12/18	122/116/110	128	1 license key required to enable the full capacity of a 14U library

Table 2-4. Licensable cartridge slots (storage and I/O) per model (continued)

Library Configuration	Number of Available I/O Station Slots*	Number of Accessible Storage Slots	Total Slots**	Capacity Expansion License Keys
23U library (control module + 2 9U expansion modules)	6/12/18/24/30	122/116/110/104/98	128	no license key
	6/12/18/24/30	168/162/156/150/144	174	each license key enables full capacity of one 9U expansion module
	6/12/18/24/30	212/206/200/194/188	218	2 license keys required to enable the full capacity of a 23U library
32U library (control module + 3 9U expansion modules)	6/12/18/24/30/36/42	168/162/156/150 144/138/132	174	no license key
	6/12/18/24/30/36/42	212/206/200/194 188/182/176	220	each license key enables full capacity of one 9U expansion module
	6/12/18/24/30/36/42	260/254/248/242 236/230/124	266	2 license keys enable an additional 46 slots on each of two 9U expansion modules
	6/12/18/24/30/36/42	304/298/292/286 280/274/268	310	3 license keys required to enable the full capacity of a 32U library

Table 2-4. Licensable cartridge slots (storage and I/O) per model (continued)

Library Configuration	Number of Available I/O Station Slots*	Number of Accessible Storage Slots	Total Slots**	Capacity Expansion License Keys
41U library (control module + 4 9U expansion modules)	6/12/18/24/ 30/36/ 42/48/54	212/206/200/194 188/182/176/ 170/164	220	no license key
	6/12/18/24/ 30/36/ 42/48/54	260/254/248/242 236/230/224/ 218/212	266	each license key enables full capacity of one 9U expansion module
	6/12/18/24/ 30/36/ 42/48/54	304/298/292/286 280/274/268/ 262/256	312	2 license keys enable an additional 46 slots on each of two 9U expansion modules
	6/12/18/24/ 30/36/ 42/48/54	352/346/340/334 328/322/316/ 310/304	358	3 license keys enable an additional 46 slots on each of three 9U expansion modules
	6/12/18/24/ 30/36/ 42/48/54	396/390/384/378 372/366/360/ 354/348	402	4 license keys required to enable the full capacity of a 41U library

*The I/O station in the 9U expansion module, contains 12 slots which can be configured as either I/O or storage slots. If the 9U expansion module I/O slots are configured as I/O, the control module slots can be configured as storage slots.

**The number of available I/O and storage slots listed in the table above are adjusted for the unusable slots in each configuration that are not accessible due to space restrictions which limit the movement of the Picker. The M2 Picker will provide an additional 5 or 7 slots, depending upon the library configuration and the number of Capacity Expansion license keys purchased.

Path Failover (Feature Code 1682)

The Path Failover feature includes license keys for activating control path failover and data path failover. Path Failover is a combination of two previous features: Control Path Failover (key entered at the library user interface) and Data Path Failover (key entered at the device driver interface). A single activation key entered at the library user interface now activates both features, with one exception. For LTO Ultrium 3 drives with firmware level 73P5 or lower, the device driver interface Data Path Failover key activation will still be required. The Path Failover feature is available on select drives.

Control Path Failover

A control path is a logical path into the library through which a server sends standard SCSI Medium Changer commands to control the logical library. Additional control paths reduce the possibility that failure in one control path will cause the entire library to be unavailable. Use of the control path failover feature further reduces that possibility.

Data Path Failover

Data Path Failover is designed to provide a failover mechanism in the IBM device driver, which enables you to configure multiple redundant paths in a SAN environment. In the event of a path or component failure, the failover mechanism is designed to automatically provide error recovery to retry the current operation using an alternate, pre-configured path without aborting the current job in progress. This allows you flexibility in SAN configuration, availability, and management.

Encryption (Feature Code 5900)

The TS3310 library supports host encryption on LTO Ultrium 5 Fibre Channel drives when used with LTO Ultrium 4 or LTO Ultrium 5 data cartridges. The TS3310 library supports host encryption on LTO Ultrium 4 Fibre Channel and SAS drives when used with LTO Ultrium 4 data cartridges. The TS3310 library supports three configurations for establishing encryption policy and providing encryption keys to the drive:

- Application Managed Encryption (AME). Encryption policies and keys are established and provided by the host application. This is a standard feature for all Ultrium 4 and Ultrium 5 drives in the TS3310 library. Since the application manages the encryption keys, volumes written and encrypted using the AME method can only be read by the same application that wrote them.
- System Managed Encryption (SME). SME encryption key generation and management is performed by the IBM Encryption Key Manager (EKM), a Java application running on a system-attached host. SME policies are established by enabling the SME capability on one or more instances of the IBM device driver, which will also be used as a proxy between a key server and the drive for providing encryption keys to the drive. This encryption configuration is transparent to the host application. SME requires the Transparent LTO Encryption license key (Feature Code 5900).
- Library Managed Encryption (LME). LME encryption key generation and management is performed by the IBM Encryption Key Manager (EKM), a Java application running on a library-attached host. LME policies are established by the library, which may also be used as a proxy between a key server and the drive for providing encryption keys to the drive. This encryption configuration is transparent to the host application. LME requires the Transparent LTO Encryption license key (Feature Code 5900).

  For details on testing the configuration path for LME enabled libraries, see "LME Key Path Diagnostics in the Setup and Operator Guide.

System-managed tape encryption and library-managed tape encryption interoperate with one another. Therefore, a tape encrypted using SME may be decrypted using LME, and vice versa, provided they both have access to the same keys and certificates.

Encryption Key Management (EKM) is a Java software program that assists encryption-enabled tape drives in generating, protecting, storing, and maintaining encryption keys that are used to encrypt information being written to, and decrypt information being read from, tape media. You must supply a server or servers on which to install EKM. It is strongly recommended that you use both a primary and secondary EKM server.

For information on how to install, configure, and use the EKM, see the *IBM Encryption Key Manager component for the Java platform, Introduction, Planning and User's Guide GA76-0418*, and the *IBM Encryption Key Manager component for the Java*

platform, Quick Start Guide for LTO Ultrium 4 GA76-0420, which are both available for download at: http://www-1.ibm.com/support/docview.wss?uid=ssg1S4000504.

For information on how to install, configure, and use the Tivoli Key Lifecycle Manager (TKM), see the *IBM Tivoli Key Lifecycle Manager Quick Start Guide (GI11-8738)* and *IBM Tivoli Key Lifecycle Manager Installation and Configuration Guide (SC23-9977)*.

IBM Tivoli® Key Lifecycle Manager V1.0 (English) publications may be downloaded from the following Web site: http://www.ibm.com/software/tivoli/library.

Library & Drive Code Update (Feature Code 0500)

Order feature code 0500, Library and Drive Code Update, if you would like an IBM Service Representative dispatched to your location to update your library and drive firmware.

Location Coordinates

A numbering system is used to identify components of the library. The library location coordinates contain the following digits: [Module],[Column],[Slot]. The figure below illustrates how a library with a control module and an expansion module are numbered.

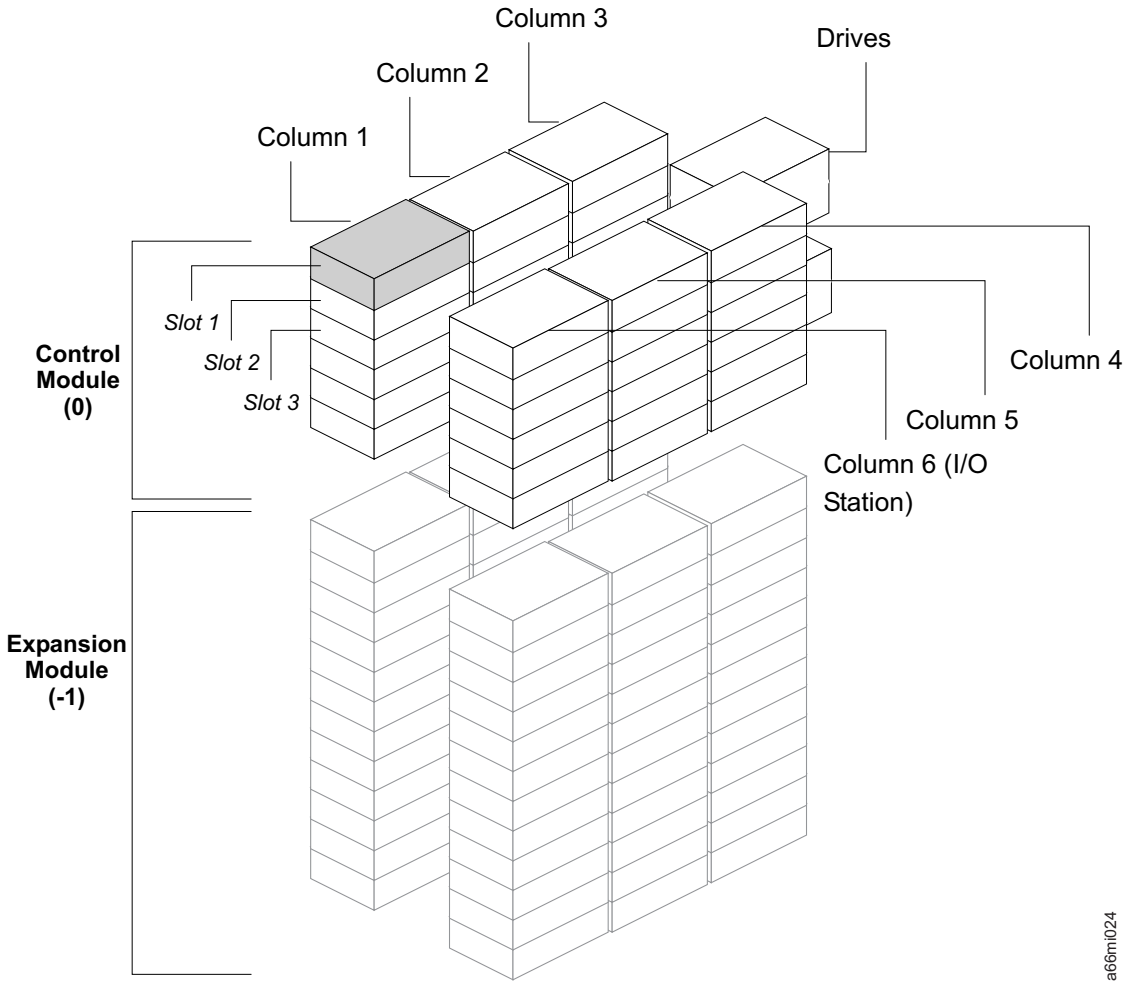


Figure 2-12. Library Location Coordinates

The module digit uses a zero-based numbering system. The control module is labeled as 0 (zero). The front, left-most column in the module is labeled 1. The top slot in each column is labeled 1. For more information, refer to the sections that follow.

Modules

Library modules are represented by the first digit of a library coordinate. Modules are identified relative to the control module (CM). The CM is number 0. Modules stacked above the CM are addressed with positive integer digits depending on their position above the CM. For example, the expansion module stacked directly above the CM is number 1. The expansion module stacked directly above module 1 is number 2, and so on.The module(s) stacked below the CM is numbered with a negative integer depending on its relative position to the CM. The expansion module directly below the CM is number -1. If there is an expansion module installed above the CM, it will be numbered +1.The expansion module stacked directly below module -1 is number -2, and so on.

Columns

A storage column is a group of slots arranged vertically in the library. Columns are represented by the second digit of a library coordinate. Columns are identified relative to the front left of the library. The column in the front left of the library is

number 1. The column numbering continues around the library in a clockwise direction. The I/O Station column is always number 6.

Slots

Fixed storage slots are represented by the third digit of the library location coordinate. Slots are numbered from top to bottom within each column starting with 1 at the top of the column.

Drives

Drives are addressed by module and drive bay within a module. The drive bays within a module are numbered from top to bottom. A one-based numbering system is used. The top drive bay is drive bay 1. A full address of a drive is of the form [Module, Drive Bay], examples: [0,1], [-1,2].

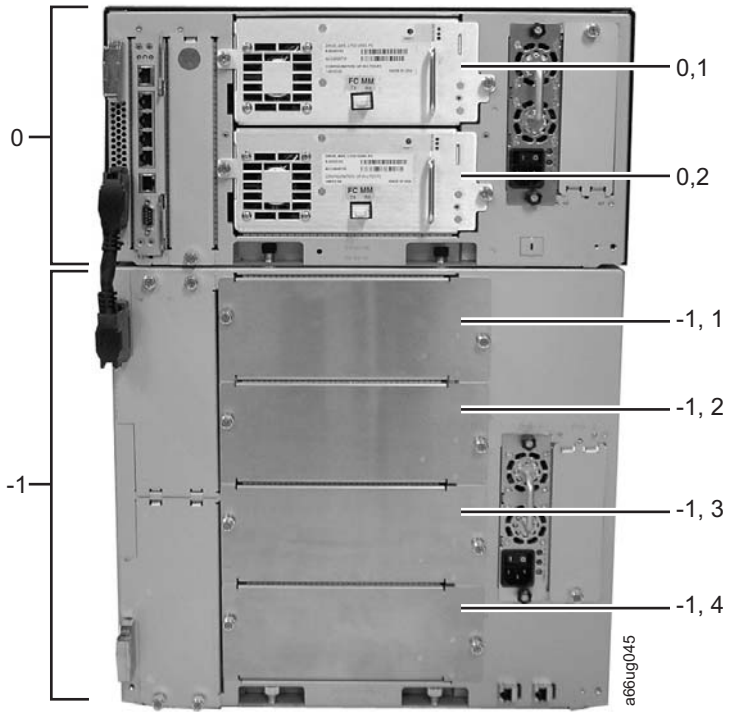


Figure 2-13. Drive location coordinates

Power Supplies

Power supplies are addressed as [Module, PS#], where PS# is 1 for the left supply and 2 for the right, as viewed from the rear of the library.

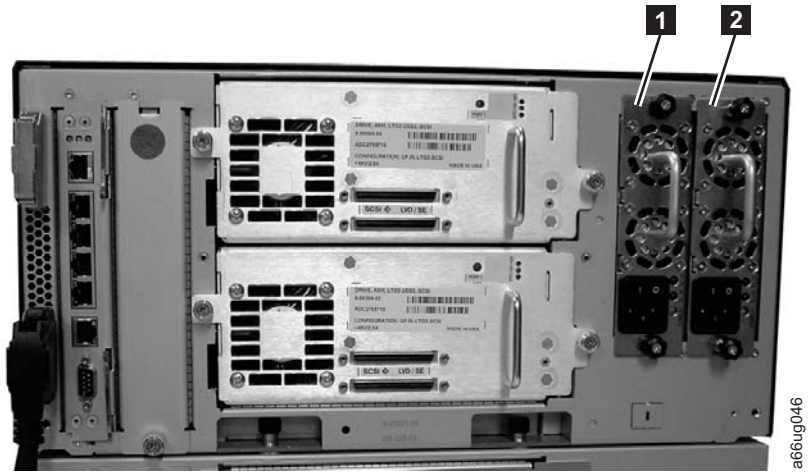


Figure 2-14. Power supply location coordinates

1	0, 1 (PS1 primary power supply in a control module)	2	0, 2 (PS2 redundant power supply in a control module)

Data Cartridges

The different generations of IBM TotalStorage Ultrium data cartridges can be identified by color:

- The Ultrium 5 Data Cartridge is burgundy
- The Ultrium 5 WORM Data Cartridge is burgundy and silver gray
- The Ultrium 4 Data Cartridge is green
- The Ultrium 4 WORM Data Cartridge is green and silver gray
- The Ultrium 3 Data Cartridge is slate blue
- The Ultrium 3 WORM Data Cartridge is slate blue and silver gray
- The Ultrium 2 Data Cartridge is purple
- The Ultrium 1 Data Cartridge is black

All generations contain 1/2-inch, dual-coat, metal-particle tape.

The native data capacity of Ultrium data cartridges is as follows:

- The Ultrium 5 cartridge has a native data capacity of 1500 GB (3000 GB at 2:1 compression)
- The Ultrium 4 cartridge has a native data capacity of 800 GB (1600 GB at 2:1 compression)
- The Ultrium 3 cartridge has a native data capacity of 400 GB (800 GB at 2:1 compression).
- The Ultrium 2 cartridge has a native data capacity of 200 GB (400 GB at 2:1 compression).
- The Ultrium 1 cartridge has a native data capacity of 100 GB (200 GB at 2:1 compression).

When processing tape in the cartridges, Ultrium Tape Drives use a linear, serpentine recording format.

- The Ultrium 5 cartridge stores data on 1280 tracks, sixteen tracks at a time

- The Ultrium 4 cartridge stores data on 896 tracks, sixteen tracks at a time.
- The Ultrium 3 cartridge stores data on 704 tracks, sixteen tracks at a time.
- The Ultrium 2 cartridge stores data on 512 tracks, eight tracks at a time.
- The Ultrium 1 cartridge stores data on 384 tracks, eight tracks at a time.

The first set of tracks (sixteen for Ultrium 5, 4 and 3; eight for Ultrium 2 and 1) is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the cartridge is full, or until all data is written.

Figure 2-15 shows the IBM TotalStorage LTO Ultrium 800 GB Data Cartridge and its components. All LTO family data cartridges are similar.

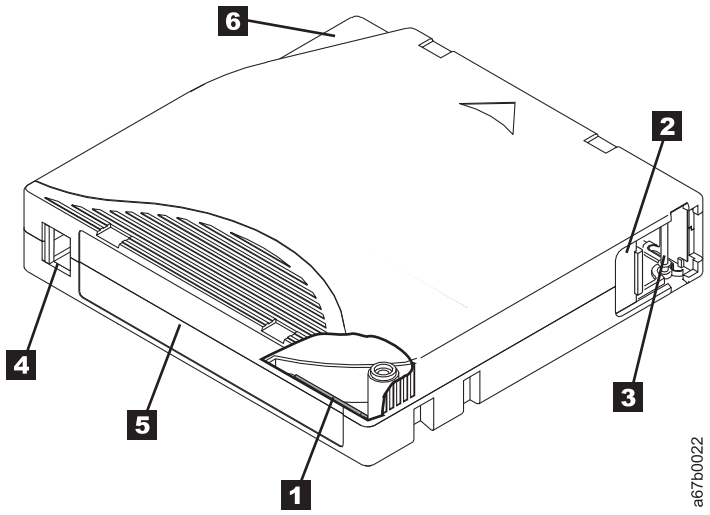


Figure 2-15. Ultrium Cartridge

1	Linear Tape-Open Cartridge Memory (LTO-CM) chip	4	Write-protect switch
2	Cartridge door	5	Label area
3	Leader pin	6	Insertion guide

All generations of the IBM LTO Ultrium Data Cartridge contain a Linear Tape-Open Cartridge Memory (LTO-CM) chip in the cartridge (1 in Figure 2-15). The cartridge memory chip contains information about the cartridge and the tape, such as the name of the manufacturer that created the tape, and statistical performance and usage information (such as number of loads/unloads). The CM reader uses a radio-frequency interface to read this information when the cartridge is loaded into the drive. The cartridge statistics are updated just before the cartridge is unloaded.

The cartridge door (2 in Figure 2-15) protects the tape from contamination when the cartridge is out of the drive. Behind the door, the tape is attached to a leader pin (3 in Figure 2-15). When the cartridge is inserted into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a non-removable take-up reel. The head can then read or write data from or to the tape.

The write-protect switch (4 in Figure 2-15 on page 2-32) prevents data from being written to the tape cartridge. .

The label area (5 in Figure 2-15 on page 2-32) provides a location to place a label. .

The insertion guide (6 in Figure 2-15 on page 2-32) is a large, notched area that prevents the cartridge from being inserted incorrectly.

Generation 3 and 4 of the LTO Ultrium Data Cartridge have a nominal cartridge life of 20,000 (20k) load and unload cycles. Generation 2 has a nominal cartridge life of 10,000 (10k) load and unload cycles. Generation 1 of the LTO Ultrium Data Cartridge has a nominal cartridge life of 5000 (5k) load and unload cycles.

Environmental and Shipping Specifications for Tape Cartridges

Before you use a tape cartridge, acclimate it to the operating environment for 24 hours or the time necessary to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the cartridge was exposed).

The best storage container for the cartridges (until they are opened) is the original shipping container. The plastic wrapping prevents dirt from accumulating on the cartridges and partially protects them from humidity changes.

When you ship a cartridge, place it in its jewel case or in a sealed, moisture-proof bag to protect it from moisture, contaminants, and physical damage. Ship the cartridge in a shipping container that has enough packing material to cushion the cartridge and prevent it from moving within the container.

The following table gives the environment for operating, storing, and shipping LTO Ultrium Tape Cartridges.

Table 2-5. Environment for operating, storing, and shipping the LTO Ultrium Tape Cartridge

	Environmental Specifications			
Environmental Factor	**Operating**	**Operational Storage**[1]	**Archival Storage**[2]	**Shipping**
Temperature	10 to 45°C(50 to 113°F)	16 to 32°C(61 to 90°F)	16 to 25°C(61 to 77°F)	-23 to 49°C(-9 to 120°F)
Relative humidity (non-condensing)	10 to 80%	20 to 80%	20 to 50%	5 to 80%
Maximum wet bulb temperature	26°C(79°F)	26°C(79°F)	26°C(79°F)	26°C(79°F)

Note:

1. The short term or operational storage environment is for storage durations of up to six months.
2. The long term or archival storage environment is for durations of six months up to ten years.

Multi-Path Architecture

Storage Area Network (SAN)-ready Multi-Path Architecture allows homogeneous or heterogeneous open systems applications to share the library's robotics without middleware or a dedicated server (host) acting as a library manager. The Multi-Path Architecture is compliant with the following attachment interfaces:

- Ultra160 SCSI
- Fibre Channel
- SAS (Serial Attached SCSI)

The library is certified for SAN solutions (such as LAN-free backup). LAN-free drive sharing is not available on SAS drives.

Multi-Path Architecture allows additional control paths and data paths to be configured for any one logical library.

Using Multiple Control Paths

The lowest physical drive in a logical library is automatically set as the control path drive for that logical library. Each drive in a logical library can be a control path drive.

Command failures and time-outs are costly. Customers want their libraries to run smoothly and efficiently. To ensure continued processing, the library offers an optional control path failover feature that enables the host device driver to send the same command to an alternate control path. With control path failover installed, the alternate control path can include another HBA, SAN, or library control path drive. The device driver initiates error recovery and continues the operation on the alternate control path without interrupting the application. AIX, HP-UX, Linux, Solaris, and Windows hosts are currently supported for this feature.

The control path failover feature is activated by entering a license key into the library. To order the feature, call an IBM Sales Representative.

For more information on control paths, refer to the *Setup and Operator Guide* for this library.

Using Multiple Data Paths for Data Path Failover

The Path Failover feature (Feature Code 1682) includes the Control Path Failover function and the Data Path Failover function.

Data Path Failover and Load Balancing functions exclusively support native Fibre Channel Tape Drives in the library using the IBM device driver. Data Path Failover is designed to provide a failover mechanism in the IBM device driver for AIX, Linux, Solaris, and Windows, which enable multiple redundant paths to be configured in a SAN environment. In the event of a path or component failure, the failover mechanism is designed to automatically provide error recovery to retry the current operation using an alternate, pre-configured path without aborting the current job in progress. This allows flexibility in SAN configuration, availability, and management.

When accessing a tape drive device that has been configured with alternate paths across multiple host ports, the IBM device driver for AIX, Linux, and Solaris automatically selects a path through the host bus adapter (HBA) that has the fewest open tape devices and assigns that path to the application. This autonomic self-optimizing capability is called Load Balancing. The dynamic load balancing support is designed to optimize resources for devices that have physical connections to multiple HBAs in the same machine. The device driver is designed to dynamically track the usage on each HBA as applications open and close devices, and balance the number of applications using each HBA in the machine. This may help optimize HBA resources and improve overall performance. Further,

Data Path Failover provides autonomic self-healing capabilities similar to Control Path Failover, with transparent failover to an alternate data path in the event of a failure in the primary host-side path.

Data Path Failover is not available on HP-UX at this time.

The Data Path Failover and Control Path Failover features are activated by the Path Failover license key (Feature Code 1682). .

For additional information, refer to your device driver documentation.

Lightweight Directory Access Protocol (LDAP)

Local authentication control is managed on the library. An administrator sets up accounts and privileges on the library. To use local authentication, a user must enter a local user name and password. Remote authentication is managed by an LDAP server. Enabling LDAP allows existing user accounts residing on an LDAP server to be integrated into the library's current user account management subsystem. User account information is centralized and shared by different applications, simplifying user account management tasks.

Administrative users can configure and enable LDAP. Once LDAP is enabled, users can access the library with either LDAP or local authentication. To use LDAP authentication, a user must enter a directory service user name and password and specify an LDAP domain. To use local authentication, a user must enter only a local user name and password.

Administrative users can add, delete, and modify only local user account information. The library web client and operator panel do not allow you to create, modify, or delete user account information about an LDAP server. This procedure must be done by the directory service provider. Refer to your server documentation for more information regarding LDAP user accounts.

LDAP server guidelines

The library supports user account information in the schema defined by RFC 2307. For LDAP users with user privileges, access to library logical libraries is determined by group assignment on the LDAP server. Groups must be created on the LDAP server with names that correspond to the library logical library names. Users with user privileges must be assigned to these groups on the LDAP server to have access to the corresponding logical libraries on the library. LDAP users with administrative privileges have access to all logical libraries and administrative functions and do not need to be assigned to logical library-related groups on the LDAP server. The following groups must be created on the LDAP server to enable remote login on the library:

- Library user group - Assign users to this group who need user-privilege access to the library. Enter the name of this group in the **User Group** field on the **Manage Access** > **Authentication Settings** screen on the library web client.
- Partition groups - For LDAP users with user privileges, access to library partitions is determined by group assignment on the LDAP server. Groups must be created on the LDAP server with names that match the library partition names (names must match but are not case-sensitive). Users with user privileges must be assigned to these groups on the LDAP server to have access to the corresponding partitions on the library.

- Library admin group - Assign users to this group who need administrator-privilege access to the library. LDAP users with administrator privileges have access to all partitions and administrator functions and do not need to be assigned to partition-related groups on the LDAP server. Enter the name of this group in the **Administrator Group** field on the **Manage Access** > **Authentication Settings** screen on the library web client.

You need to have at least one user assigned to both the Library User Group and the Library Admin Group on the LDAP server in order to test the LDAP settings on the library. Since most normal users are not members of both these groups, you might need to create a special or temporary user specifically for this purpose.

Kerberos

Kerberos Authentication is a standard (RFC 1510) third-party authentication protocol that provides end-to-end security for distributed computing environments.

Note: The web client login screen gives the user a choice between using local authentication or LDAP authentication. If LDAP authentication is selected, the user is prompted for the LDAP domain.

The Operator Panel login screen gives the user the choice between using Local authentication and Remote authentication when LDAP access is enabled. If LDAP access is disabled, the Remote authentication option does not appear on the login screen.

With Local authentication the user name and password are stored on the library. With LDAP authentication the user name and password are stored on a server.

Kerberos requires LDAP information, but LDAP users are not required to use Kerberos.

Specifications

Table 2-6. Physical specifications for the library

Physical Specification	Measurement	
	5U control module	9U expansion module
Width	44.45 cm (17.5 in.)	44.45 cm (17.5 in.)
Depth	76.83 cm (30.25 in.)	76.83 cm (30.25 in.)
Height	21.87 cm (8.61 in.)	40.0 cm (15.75 in.)

Table 2-7. Library component weight

Component	Weight
Drive	4.082 kg (9.0 lbs.)
Power supply	1.814 kg (4.0 lbs.)
Robotics	2.041 kg (4.5 lbs.)
5U control module chassis (empty)	21.55 kg (47.5 lbs.)
9U expansion module chassis (empty)	29.48 kg (65.0 lbs.)

Table 2-8. Power specifications for a 5U Control Module and 9U Expansion Module

Power Specification	Measurement			
	5U control module		9U expansion module	
Voltage	100 to 127 Vac.	200-240 Vac.	100 to 127 Vac.	200-240 Vac.
Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Current	2.0 A	1.0 A	2.0 A	1.0 A
Inrush current	50 A	100 A	50 A	100 A
Power	200 W	200 W	200 W	200 W
kVA	0.2	0.2	0.2	0.2
kBtu/hr	0.68	0.68	0.68	0.68
Note: 5U control module measurements include two tape drives. 9U expansion module measurements include four tape drives. Measurements were taken while the picker/robot assembly was randomly moving and all of the drives were reading and writing.				

Table 2-9. Other specifications for the library

Specification	Measurement
Maximum altitude	2500 m (8202 ft) for operating and storage

Table 2-10. Environmental specifications for the library

Environmental Factor	Operating (see Note)	Storage	Shipping
Drive temperature	10 to 38°C (50 to 100°F)	10 to 43°C (50 to 109.4°F)	-40 to 60°C (-40 to 140°F)
Heat output	542 W (483 Cal/Hr)	Not applicable	Not applicable
Relative humidity	20 to 80%	10 to 90%	10 to 90%
Maximum wet bulb temperature	26°C (79°F) max.	27°C (80.6°F) max.	29°C (84.2°F) max.
Note: The operating environment of the library must not conflict with the media storage requirements (see the section about media storage requirements in the Setup and Operator Guide). The library may be capable of operating at elevated temperatures for an extended period of time, the temperature could shorten the useful life of media that is stored in the library. If media is stored in the library for more than 10 hours, the storage temperature requirements for media should be met. It should be assumed that media stored in the library will be 2 degrees above ambient temperature when the library is powered ON.			

Product Environment

The library is designed to operate in a general business environment.

The library meets the acoustical requirements for general business area category 2D. Category 2D states that the library should be installed a minimum of 4 m (13 ft.) from a permanent work station.

To allow for service access, install the library a minimum of 0.9 m (3 ft.) from all obstacles.

The library is a precision computer peripheral. To ensure maximum longevity of your library, locate the library away from dust, dirt, and airborne particulates:

- Keep the library away from high-traffic areas, especially if the floor is carpeted. Carpeting harbors dust and people walking on the carpet can cause the carpet fibers and the dust to become airborne.
- Keep the library out of printer/copier rooms because of toner and paper dust. Additionally, do not store paper supplies next to the library.
- Keep the library away from moving air caused by doorways, open windows, fans, and air conditioners.

Ensure that the machine covers are always kept closed to minimize any contamination from airborne particles.

Maintenance Plan

The library consists of two hardware subsystems, the library and the tape drives. The tape drive is packaged in a common drive sled and each drive sled is a CRU. When a drive failure occurs, the drive sled is removed and returned to IBM for repair. The library maintenance package supports the library and the library interfaces with the tape drives.

Maintenance Start

Start all maintenance activity for the library using the information in Chapter 1, "Start Service," on page 1-1. An error-to-action table is provided to quickly determine which procedure to use for the reported problem. You are also shown how to prepare the library for service. Subsystem problem determination information is included to help determine the failing components.

Supported Servers, Operating Systems, and Software

The library is supported by a wide variety of servers (hosts), operating systems, and adapters. These attachments can change throughout the life cycle of the product.

To determine the latest supported attachments, visit the web at **http://www.ibm.com/storage/lto**, and look at the **Interoperability Matrix**.

Supported Device Drivers

IBM maintains the latest levels of device drivers and driver documentation for the library on the Internet. You can use one of the following procedures to access this material. **(Note: If you do not have Internet access and you need information about device drivers, contact your Marketing Representative.)**

- Using a browser, type one of the following:
  - **http://www.ibm.com/storage/lto**
  - **ftp://ftp.software.ibm.com/storage/devdrvr**
- Using File Transfer Protocol (FTP), enter the following specifications:
  - FTP site: `ftp.software.ibm.com`
  - IP Addr: `207.25.253.26`
  - Userid: `anonymous`
  - Password: (use your current email address)
  - Directory: `/storage/devdrvr`

IBM provides Portable Document Format (.pdf) and Postscript (.ps) versions of its device driver documentation in the `/storage/devdrvr/Doc` directory:

- IBM_tape_IUG.pdf contains the current version of the *IBM Tape Device Drivers Installation and User's Guide*.
- IBM_tape_PROGREF.pdf contains the current version of the *IBM Tape Device Drivers Programming Reference*.

A list of device drivers for each supported server appears at `/storage/devdrvr/` in the following directories:

- AIX
- HP-UX
- LINUX
- Solaris
- Windows

Note: The device driver for the AS/400® server and iSeries® server is included in the OS/400® operating system.

For more information about device drivers, refer to any of the preceding directories.

Chapter 3. Library Components

Become familiar with each of these components and how they can be accessed for service.

"14U Library, Front view, I/O Station Door Open" on page 3-2

"Library Rear View" on page 3-2

"I/O Station Lock Assembly" on page 3-3

"I/O Station with Slide Assembly" on page 3-4

"Access Door, Inside, With Operator Panel" on page 3-5

"Gear Rack" on page 3-6

"Y-Axis/Picker Assembly and M2 Robot Assembly" on page 3-6

"Cable Spool Assembly" on page 3-9

"Library Control Blade (LCB)" on page 3-10

"Compact Flash Card on LCB" on page 3-11

"Power Supply" on page 3-12

"Drive Sleds, Rear Panel" on page 3-13

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14U Library, Front view, I/O Station Door Open

Figure 3-1. Front view of a 14U library with the I/O Station door open

Library Rear View

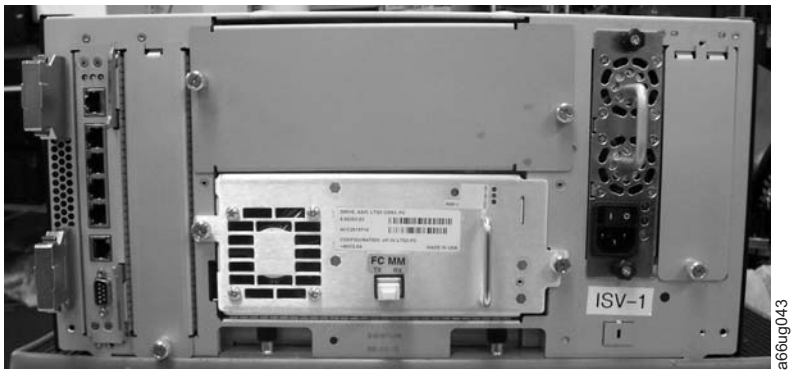

Figure 3-2. Rear view of a 5U library

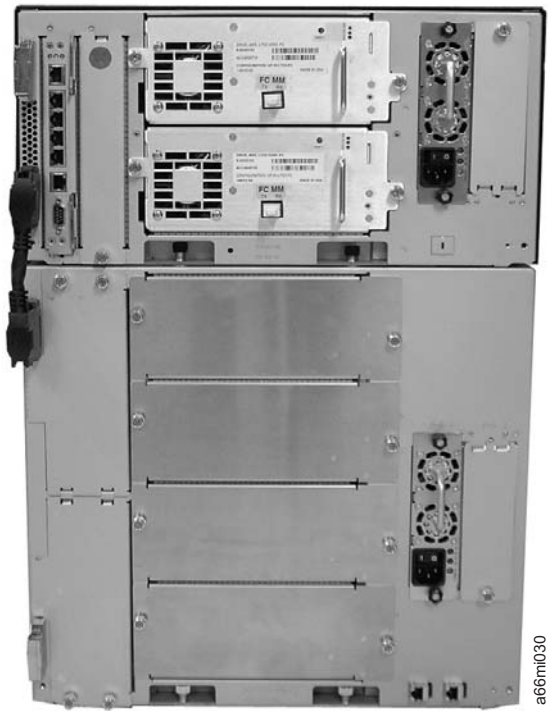

Figure 3-3. Rear view of a 14U library

I/O Station Lock Assembly

Figure 3-4. I/O Station Lock Assembly installed in the library

1	I/O Station Lock Assembly installed in the library

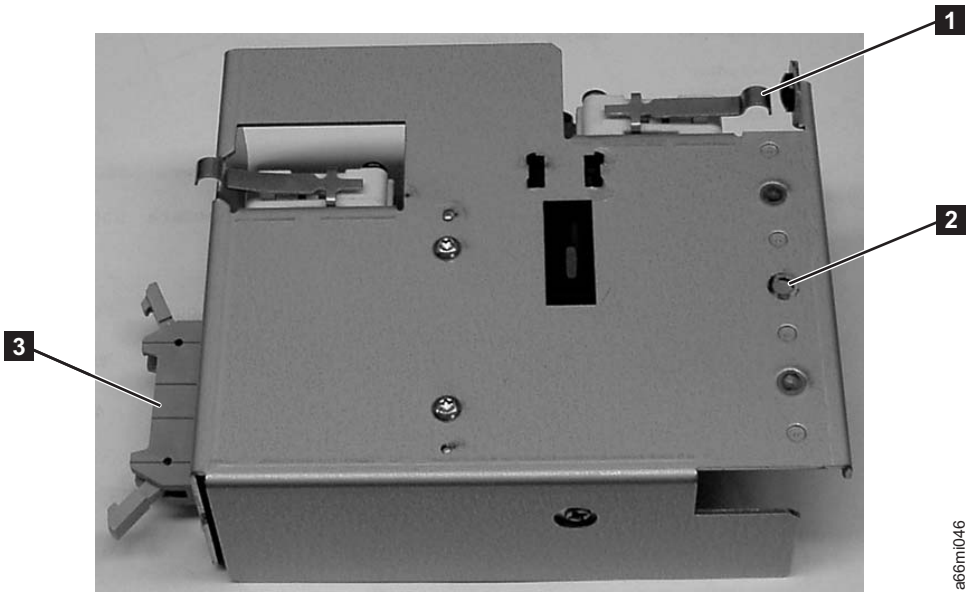

Figure 3-5. I/O Station Lock Assembly (top view)

1	Switch actuator lever	2	Mounting screw	3	I/O Station cable connector

I/O Station with Slide Assembly

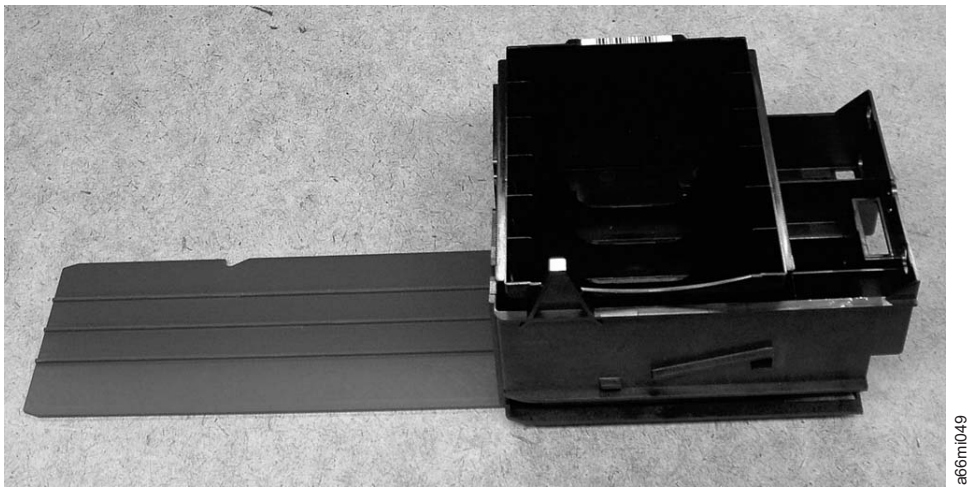

Figure 3-6. I/O Station with Slide Assembly

Access Door, Inside, With Operator Panel

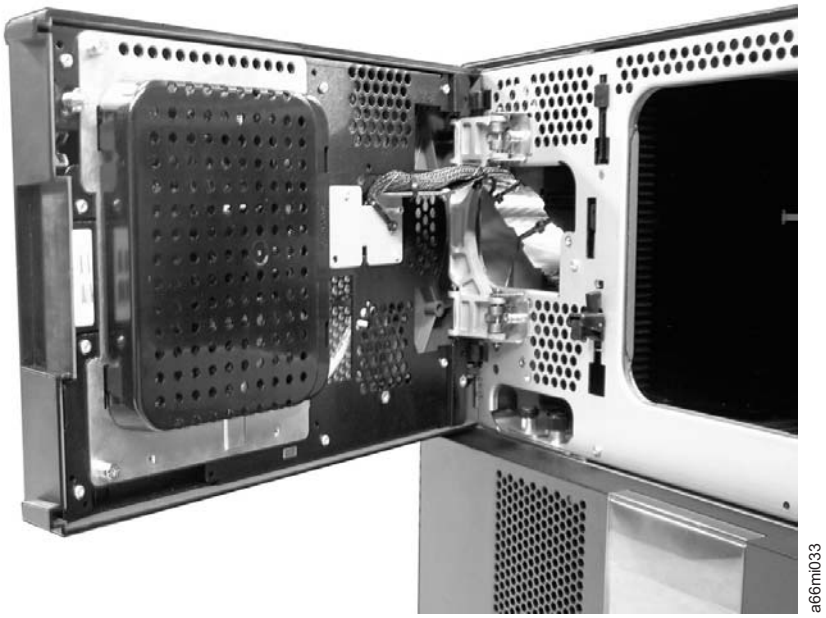

Figure 3-7. Access Door open showing back of Operator Panel

Gear Rack

Figure 3-8. Gear racks inside the library

1 Front gear rack **2** Rear gear rack

Y-Axis/Picker Assembly and M2 Robot Assembly

This section depicts the Y-Axis/Picker Assembly and the M2 Robot Assembly. Libraries contain either one or the other of these components.

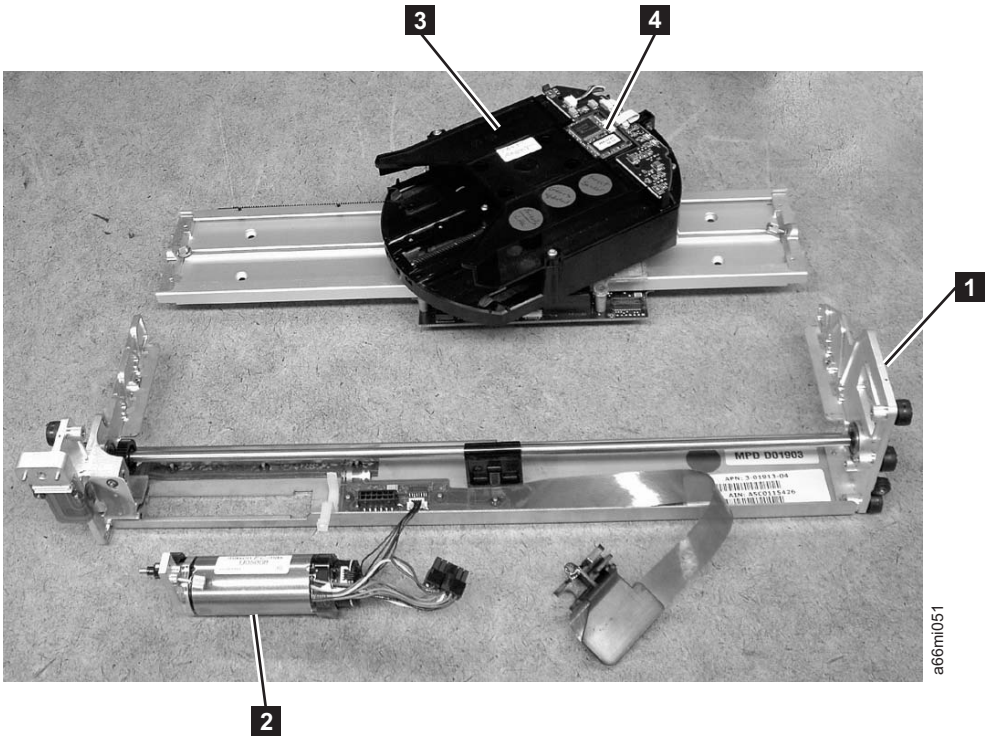

Figure 3-9. Original Y-axis/Picker Assembly

1	Y-axis Assembly	3	Picker
2	Y Motor		

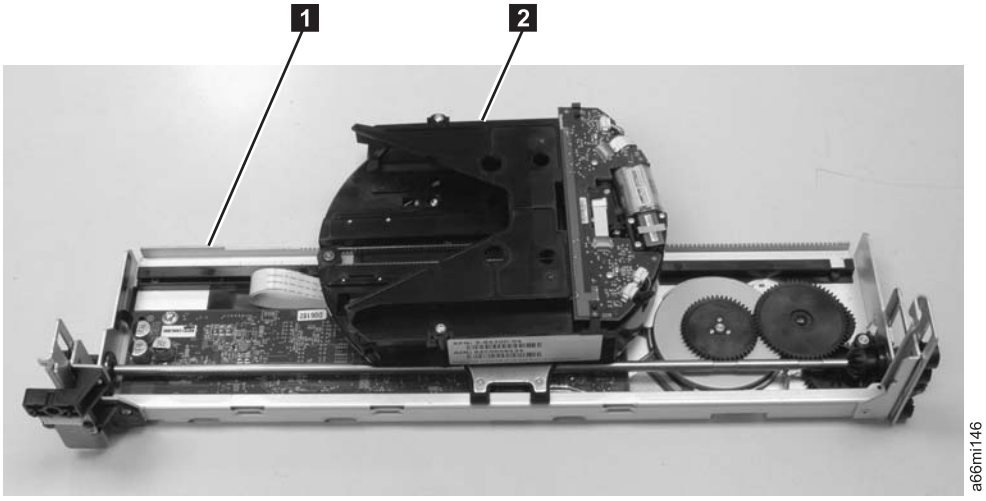

Figure 3-10. M2 Robot Assembly

1	Robot	2	M2 Picker Assembly

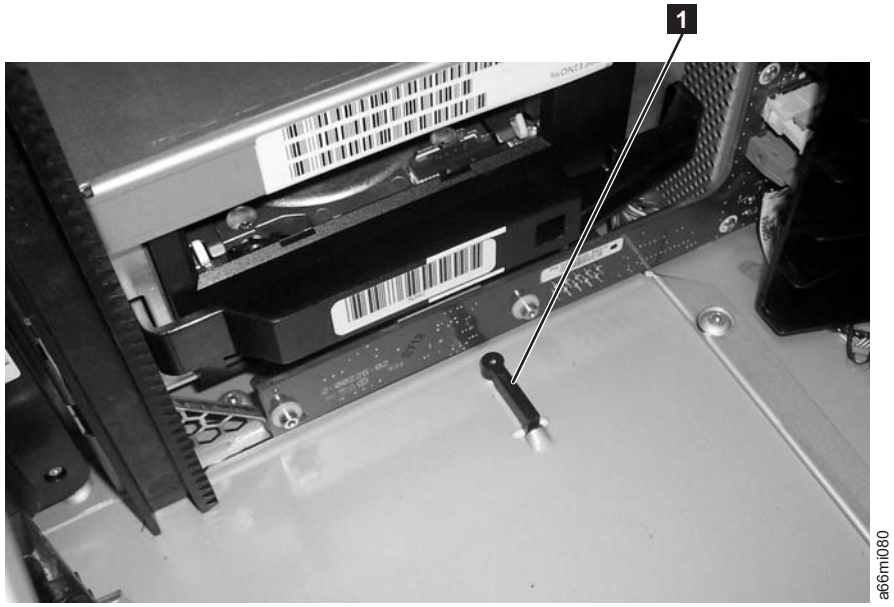

Figure 3-11. Home Sensor Flag

1 Home Sensor Flag

Cable Spool Assembly

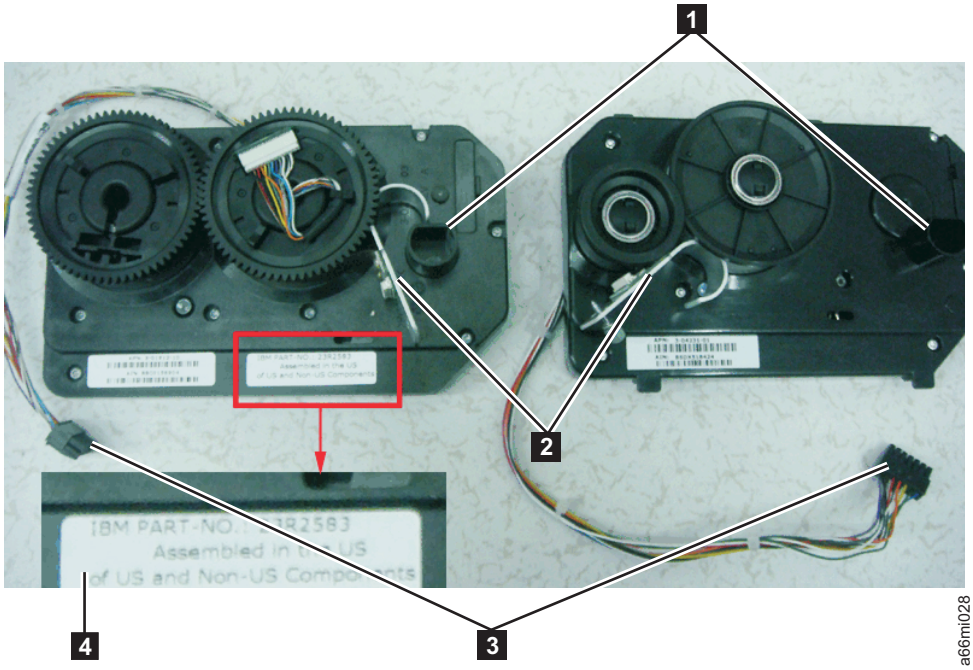

Figure 3-12. Cable spool assembly

Table 3-1. Cable Spool Assembly components

1	Plastic guide peg	2	Spooler flat cable handle	3	Terminal Board	4	IBM Part Number

The cable spool assembly in the left was from initial release (2005), the one on the right is a version from 2007. Although they look different, they are completely interchangeable, and the remove/replace procedures are the same. Either spool may be in the library and you may receive either as a Field Support Unit (FRU). The part number for both is the same. See “Cable Spool Assembly” on page 7-110.

Library Control Blade (LCB)

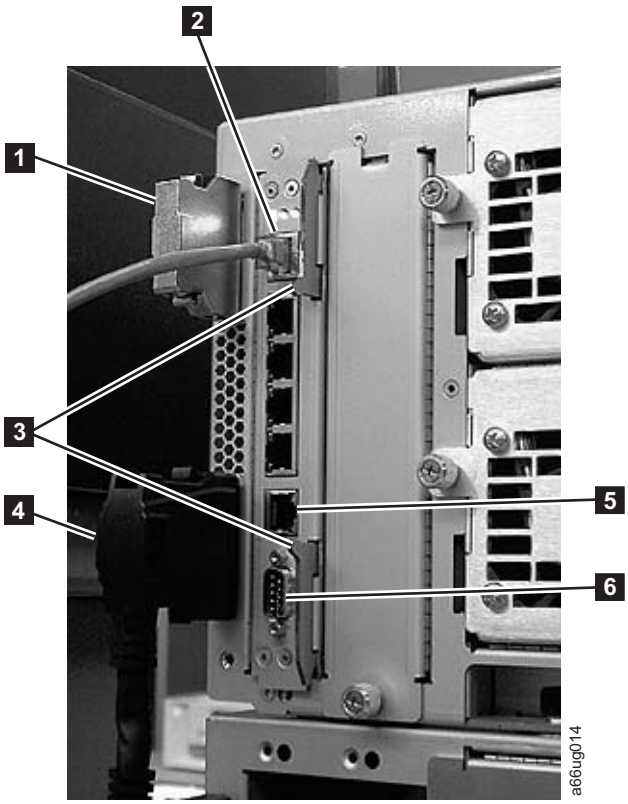

Figure 3-13. Library Control Blade (external library view)

1	Module-to-module terminator	4	Module-to-module cable
2	Ethernet cable	5	Ethernet port (for Service use)
3	Latches	6	Serial port (for Service use)

Compact Flash Card on LCB

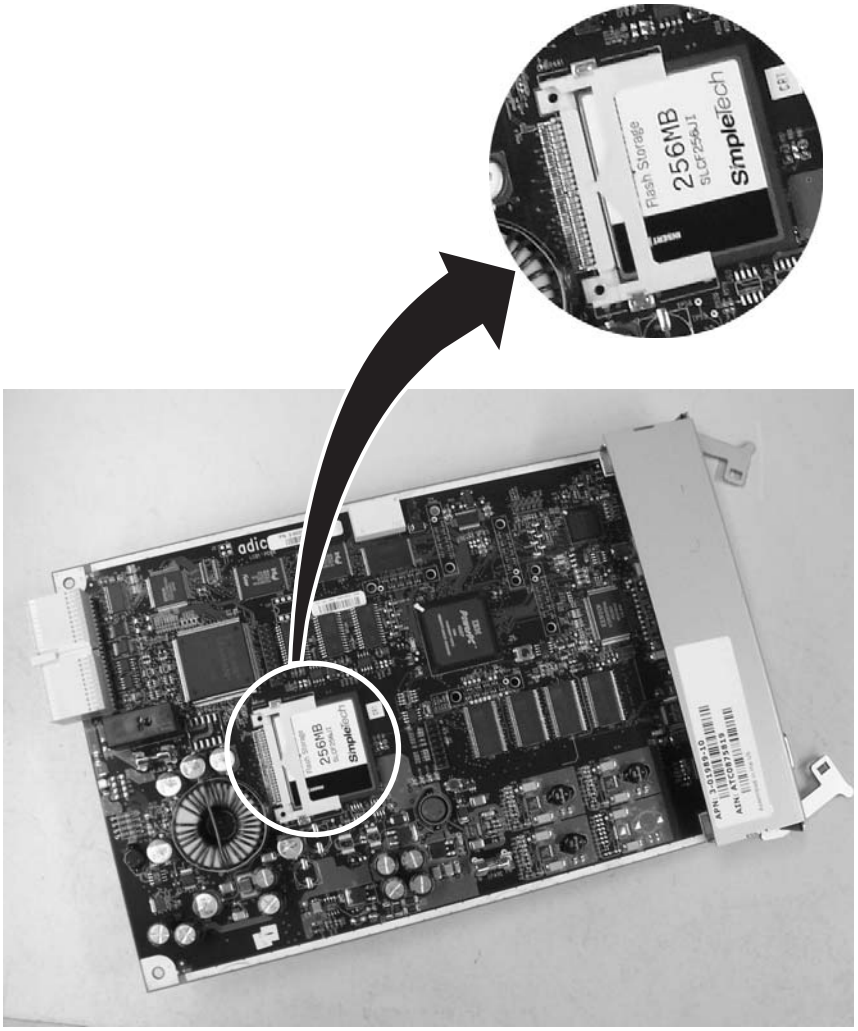

Figure 3-14. Library Control Blade and Compact Flash Card

Power Supply

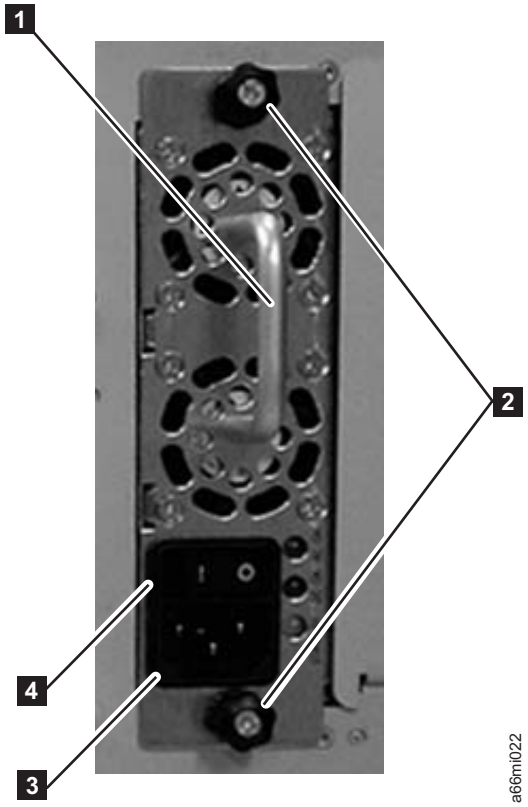

Figure 3-15. Power Supply

1	Handle	3	Power cable
2	Thumb screws	4	Power switch

Drive Sleds, Rear Panel

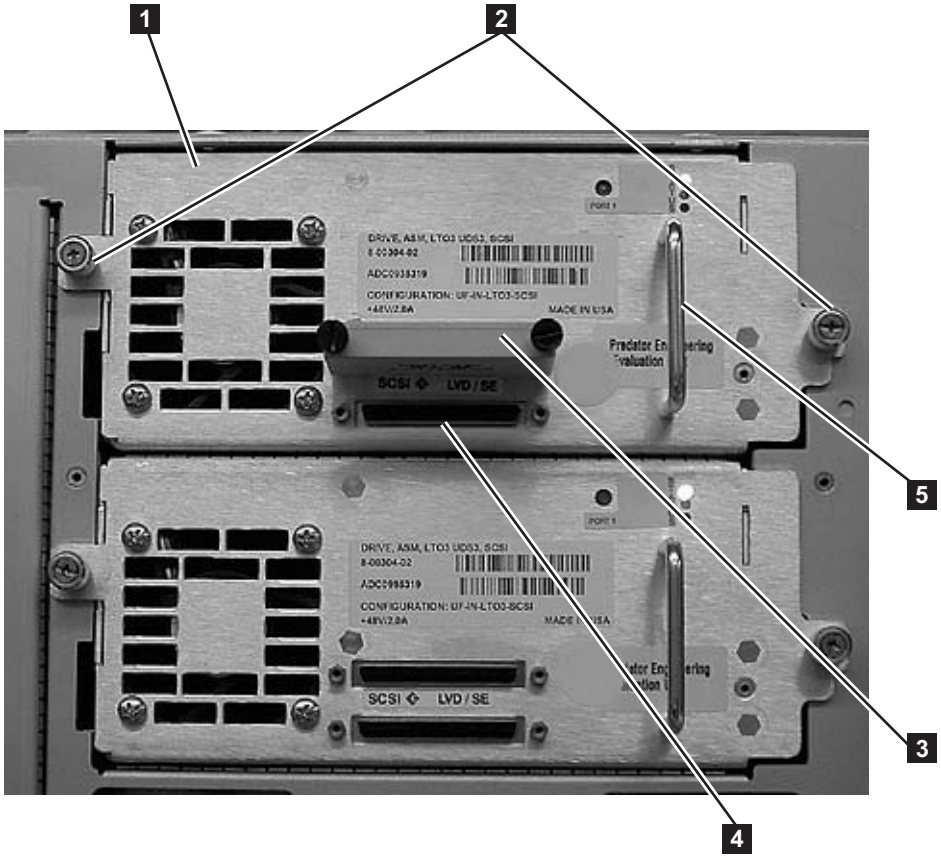

Figure 3-16. LTO 3 drive sleds

1	Tape drive sled	4	SCSI cable receptacle
2	Thumb screws	5	Handle
3	SCSI terminator		

Note: This library supports any combination of LTO 3, LTO 4, and LTO 5 drives.

Chapter 4. User Interfaces

"Operator Panel"

"Web User Interface (UI)" on page 4-7

"User Privileges" on page 4-10

The library has a local interface, the Operator Panel, and a remote Web User Interface (UI).

The Operator Panel is located on the front door of the control module (CM) and allows users to work locally on the library via the user interface. The Web UI allows users to view and perform some library functions from remote sites and is best viewed using Internet Explorer 5.0 or higher, or Firefox 1.0 or higher.

Operator Panel

The Operator Panel is physically attached to the front door of the control module (CM). The user interface appears on the touchscreen LCD display of the Operator Panel for executing basic library management functions. Audible feedback, such as "key click" sounds, are generated when a user touches a button on the touchscreen.

Operator Panel Login Screen

Figure 4-1. Operator Panel Login screen for firmware versions prior to 585G

Note: For firmware versions prior to 585G, when LDAP (Lightweight Directory Access Protocol) is enabled, the login screen gives the user a choice between

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using local authentication (the login and password are stored on the library) or LDAP authentication (the login and password are stored on a server, and the user must specify the LDAP domain name). If LDAP access is disabled, the Local and Remote authentication options will not appear on the login screen. Kerberos requires LDAP information, but LDAP users are not required to use Kerberos.

Figure 4-2. Operator Panel Login screen for firmware versions 585G and later

For initial login, the administrator should use the following:

- User name: **admin**
- Password: **secure**

To fill in the **User name**, lightly touch the blank field to display the alphabetic and numeric touch pads then, use the touch keys to spell out the user ID and touch **OK**. Similarly, enter the password and touch **OK**.

After initial login change the Administrator password. To change the password, perform the following steps:

- For firmware versions prior to 585G, the LDAP authentication choice is presented on the Operator Panel as **Remote authentication**. From the Operator Panel, select **Setup** > **User Mgmt** > **Modify User**.
- For firmware versions 585G and later, change the Administrator password. From the Operator Panel, select **Setup** > **User Mgmt** > **Modify User**.

Common Operator Panel Elements

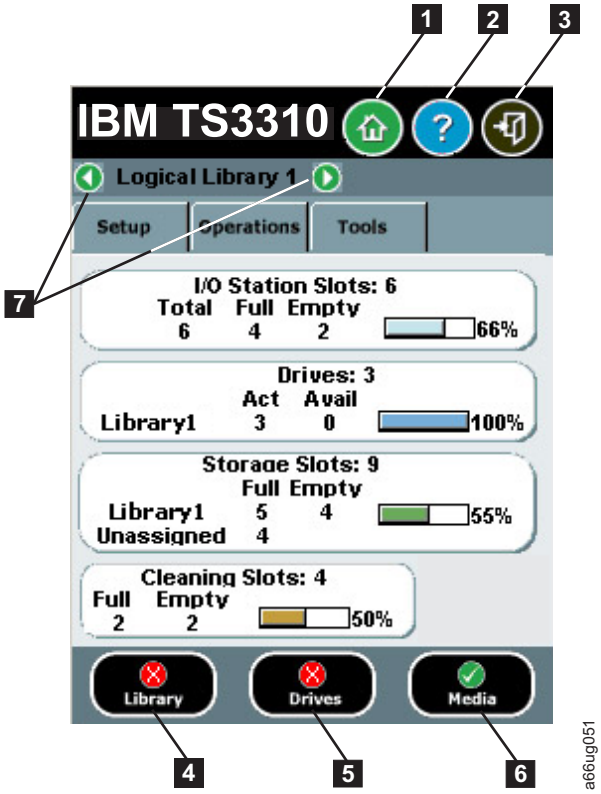

Figure 4-3. Operator Panel common header elements and subsystem status buttons

Common Header Elements

All Operator Panel screens (except for the Login screen) contain the following common elements in the header:

- **Home** (1 in Figure 4-3) - displays the default **Capacity View** screen.
- **Help** (2 in Figure 4-3) - context-sensitive help for the associated page
- **Logout** (3 in Figure 4-3) - ability to log out
- **Logical Library Name** - Displays the designation for the current logical library. You can click the arrows on either side of the library designation to scroll through other available logical libraries.

Note: When the library is busy performing certain tasks, a "Not Ready' message will display alternately with the 'IBM TS3310' notation at the top of the screen.

System Summary and Subsystem Status

The health of the library can be gauged by three subsystem status buttons located at the bottom of the home page. These buttons provide easy access to the health of the library for faster recovery if problems occur. You can select the buttons to view detailed information about the library and gain access to library subsystems. The three subsystems are:

- **Library** (4 in Figure 4-3)- opens the operator interventions for the library.
- **Drives** (5 in Figure 4-3)- opens the operator intervention screen for drives.
- **Media** (6 in Figure 4-3)- opens the operator intervention screen for media.

Each button has three states indicated by color. The three states are:

- Good - green
- Degraded - yellow (An operator intervention has been created.)
- Investigate - red (An operator intervention has been created; however, the library may still be operational.)

Keyboards

When a user touches a text box requiring data entry, a keyboard screen appears. Either the alphabetic or numeric keyboard appears, depending on the type of input field. All alphabetic character entries are lower case. The text box appears at the top of the screen and the number/characters appear as they are entered. The **123** button opens the numeric keyboard from alphabetic keyboard, The **abc** button opens the alphabetic keyboard from the numeric keyboard. The back arrow erases one character at a time.

Attention: To use the touchscreen effectively, tap lightly to make your selections.

Home Page

The **Home Page** screen provides tabular data on the capacity of the various areas of the library. Use this screen to see a quick summary of the capacity of the selected logical library based on a user login.

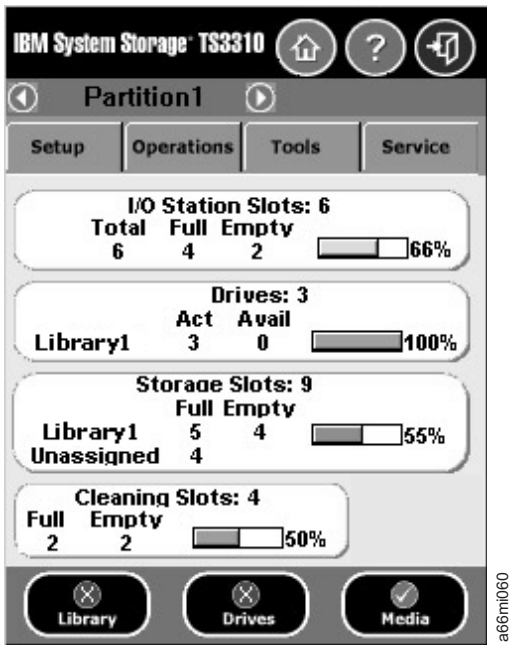

Figure 4-4. Home Screen Capacity View

If users have access to more than one logical library, they can navigate to other logical libraries using arrows next to the logical library name at the top of the screen.

If an administrative user is logged in, a view of the physical library appears.

If a user is logged in, the first logical library that they have access to, in alphabetical order, appears.

Menus Available from the Operator Panel

The following three menus organize commands into logical groups:

Note: The menus available to users with the**Admin** role are Setup, Operations, and Tools. The menus available to users with the**User** role are Operations and Tools. The menus available to the **Service** login are Setup, Operations, Tools, and Service.

- The **Setup** menu consists of commands that you can use to set up and configure various aspects of the library, including logical libraries, user management, drive settings, licenses, date and time, network management, and control path.

Figure 4-5. Setup menu screen

- The **Operations** menu consists of commands that enable you to change the library's mode of operations, insert and remove cartridges, load and unload drives, move media, and shutdown/restart the library.

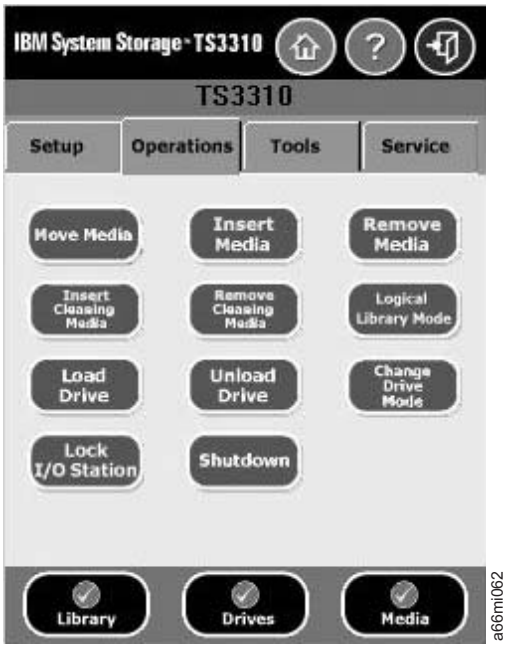

Figure 4-6. Operations menu screen

- The **Tools** menu consists of commands that you can use to maintain your library such as viewing operator interventions, capturing the library snapshot (available to Service logon only), identifying ports, and updating firmware using an FMR (Firmware) cartridge

  The Admin login has access to the Setup, Operations, and Tools menus. The Tools menu includes the service functions that can be executed by the Admin or Service login.

  Only the Service login has access to the Service menu. The Service menu includes the same service functions that are available on the **Tools** > **Service** menu..

Figure 4-7. Tools menu screen

The following menu tree shows all functions available from the Operator panel interface.

Table 4-1. Tape Library Operator Panel Menu Tree

Setup	Operations	Tools	Service
–Logical Library Mgmt	–Move Media	–Operator Interventions	–Drives
–User Mgmt	–Insert Media	–Drive Mgmt	–System
–Drive Settings	–Remove Media	–Drive Info	
–Licenses	–Insert Cleaning Media	–About Library	
–Date & Time	–Remove Cleaning Media	–Service	
–Network Mgmt	–Logical Library Mode	–Internal Network	
–Control Path	–Load Drive	–System Settings	
	–Unload Drive	–Security	
	–Change Drive Mode	–Display Settings	
	–Lock I/O Station	—Service Login only—	
	–Shutdown	–Factory Defaults	
		–Library Tests*	

*Library Tests will include Installation and Verification Test (IVT) for libraries built after July 1, 2008 with serial numbers with last four digits 8609 and above.

Web User Interface (UI)

The System Storage TS3310 web user interface supports only two browsers, either Mozilla Firefox™ version 1.0.6 and above or Microsoft® Internet Explorer™ version 6.0 and above.

To manage the library using the Web UI, you must set up the initial network configuration of the library from the Operator Panel touchscreen. For more information, see the *Setup and Operator Guide*.

Logging in to the Web User Interface

Initial login information is as follows:

- User: **admin**
- Password: **secure**

For more information on user privileges, see "User Privileges" on page 4-10.

Note: The login screen gives the user a choice between using local authentication (the login and password are stored on the library) or LDAP authentication (the login and password are stored on a server, and the user must specify the LDAP domain name).

The Local and LDAP authentication choices are always displayed on the login screen, independent of the library Authentication Settings.

Common Header Elements

All Operator Panel screens (except for the Login screen) contain the following common elements in the header:

- **Help** - context-sensitive help for the associated page
- **Logout** - ability to log out

Menus Available from the Web User Interface

The following table lists those menus that are available from the Web UI.

Table 4-2. Menus available from the Web User Interface

Welcome Page

- **Monitor System**
  - System Summary
  - Library Map
  - Logged in Users
  - Network Settings
  - Key Path Diagnostic Status
  - Advanced Reporting
    - -- Drive Utilization
    - -- Media Integrity
  - Media Security
- **Manage Cartridges**
  - Data Cartridges
  - Cleaning Cartridges
  - I/O Station
  - Lock/Unlock I/O Station Doors
- **Manage Drives**
  - Drive Summary

Table 4-2. Menus available from the Web User Interface (continued)

- Control Paths
- Drive IDs
- Fibre Channel Ports
- -- Modify Port Properties

– Manage Library

- Perform Inventory
- Setup Wizard
- Logical Libraries
- Cleaning Slots
- I/O Station Slots

– Settings

- Feature Licenses
- Date & Time
- Email Notifications
- SMTP (Mail) Configuration
- Contact Information
- Network
- SNMP Configuration
- SNMP Destinations
- -- Add
- -- Remove
- Ethernet Speed/Duplex
- Media Detection
- Save/Restore Configuration

– Manage Access

- Users
- Authentication Settings
- Set Session Timeout

– Service Library

- Operator Interventions
- Capture Library Log
- Capture Drive Log
- Media Security Log
- Media Usage Log
- Capture IVT Log*
- View/Update Library Firmware Level
- View/Update Drive Firmware Level
- Service Drives
- Shutdown/Restart Library
- Key Path Diagnostics

Table 4-2. Menus available from the Web User Interface (continued)

*Available only to Service login. Available only on libraries built after July 1, 2008 with serial numbers with last four digits 8609 and above.

User Privileges

User privilege levels are manually assigned to user accounts created within the library. Controlling access to screens and operations within the library preserves the integrity of the library and the data that is stored within the library.

There are three types of user privileges in the library.

- **Service users** are allowed access to the entire physical library and all of its logical libraries as well as access to a hidden **Service** menu that includes service tools and diagnostics.
- **Administrative users** are allowed access to the entire physical library and all of its logical libraries. One and only one administrative user must be assigned the login name **admin**.
- **Superusers** have all the privileges of Users with additional privileges associated with monitoring, operating, and servicing the library. Superusers have access to all library partitions but cannot perform the following tasks:
  - Library setup and settings
  - Changes to library configuration
  - Changes to library or drive firmware
  - Library security setup and changes
- **Users** are allowed to operate one or more assigned logical libraries, but are not allowed to perform actions that affect the physical library. See Table 4-3 for access details to the available library functions.

User privileges include:

- A screen saver is invoked after 10 minutes of inactivity on the Operator Panel. The Web User Interface (UI) does not use a screen saver.
- Up to 18 Users and/or Administrative users can be logged in at one time on the Web UI. Only one user can be logged in at one time on the Operator Panel.
- When a Service user logs in, all other Users and Administrative users are logged out and notified that they cannot perform actions on the library. A message is posted that Service is logged in and no other users can access the library until after Service has logged out.

The following table describes how to access the library functions from both the control panel and the Web UI. For each interface, column "A" indicates Administrative privileges; "S" indicates Superuser privileges; column "U" indicates User privileges. In each column, an "X" indicates that access is allowed and the settings can be modified, an "O" indicates that access is allowed but the settings can only be observed, and a "–" indicates that access is not allowed.

Table 4-3. System Functions, Commands, and Access

Function	Control Panel Menu Command and Access				Web UI Command and Access			
		A	S	U		A	S	U
Libraries								

Table 4-3. System Functions, Commands, and Access (continued)

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
Setup Wizard	N/A				**Manage Library** > **Setup Wizard**	X	—	—
Create Logical Libraries	**Setup** > **Logical Library Mgmt** > **Create Logical Library**	X	—	—	**Manage Library** > **Logical Libraries**	X	—	—
Delete Logical Libraries	**Setup** > **Logical Library Mgmt** > **Delete Logical Library**	X	—	—	**Manage Library** > **Logical Libraries**	X	—	—
Delete ALL Logical Libraries	**Setup** > **Logical Library Mgmt** > **Delete All Logical Libraries**	X	—	—	**Manage Library** > **Logical Libraries**	X	—	—
Change Logical Library Mode	**Operations** > **Logical Library Mode**	X	X	X	**Manage Library** > **Logical Libraries**	X	X*	X
Configure Encryption Settings	N/A				**Manage Library** > **Logical Libraries**	X	—	—
Perform Inventory	N/A				**Manage Library** > **Perform Inventory**	X	X	X
Display Library Information	**Tools** > **About Library**	X	X	X	**Monitor System** > **Library Map**	X	X	X
Capture Library Log	N/A				**Service Library** > **Capture Library Log**	X	X	—
Cleaning Slots	**Setup** > **Logical Library Mgmt** > **Configure Cleaning Slots**	X	—	—	**Manage Library** > **Cleaning Slots**	X	X	—
I/O Station Slots	**Setup** > **Logical Library Mgmt** > **Configure I/O Slots**	X	—	—	**Manage Library** > **I/O Station Slots**	X	—	—
I/O Station Lock/Unlock	**Operations** > **Lock I/O Station** > **Lock/Unlock**	X	X	—	**Manage Cartridges** > **Lock/Unlock I/O Station Doors**	X	X	—
Update Library Firmware	N/A				**Service Library** > **View/Update Library Firmware Level**	X	O	—
Display Advanced Reporting Reports	N/A				**Monitor System** > **Advanced Reporting**	X	X	X
Shutdown/ Restart Library	**Operations** > **Shutdown**	X	X	—	**Service Library** > **Shutdown/Restart Library**	X	X	—

Table 4-3. System Functions, Commands, and Access (continued)

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
* Superusers can access the **Logical Libraries** web page via the **Manage Library** menu but they can only execute the **Bring Online** and **Bring Offline** functions.								
Users/System Access								
Create New Users	**Setup** > **User Mgmt** > **Create User**	X	—	—	**Manage Access** > **Users**	X	—	—
Modify Users	**Setup** > **User Mgmt** > **Modify User**	X	—	—	**Manage Access** > **Users**	X	—	—
Enter License Key	**Setup** > **Licenses**	X	—	—	**Manage Library** > **Settings** > **Feature Licenses**	X	O	—
Display Logged in Users	N/A				**Monitor System** > **Logged in Users**	X	X	—
LDAP Configuration	N/A				**Manage Access** > **Authentication Settings**	X	O	—
User Session Timeout	**Tools** > **System Settings** > **User Session Timeout (Minutes)**	X	—	—	**Manage Access** > **Set Session Timeout**	X	—	—
Disable Remote Service User	**Tools** > **System Settings** > **Disable Remote Service Users**	X	—	—	N/A			
Drives		**A**		**U**		**A**		**U**
Set Drive Settings	**Setup** > **Drive Settings**	X	—	—	**Manage Drives** > **Drive IDs**	X	O	—
Load Drive	**Operations** > **Load Drive**	X	X	X	**Manage Drives** > **Drive Summary** > **Load**	X	X	X
Unload Drive	**Operations** > **Unload Drive**	X	X	X	**Manage Drives** > **Drive Summary** > **Unload**	X	X	X
Change Drive Mode	**Operations** > **Change Drive Mode**	X	X	X	**Service Library** > **Service Drives** > **Bring Online, Bring Offline, Reset**	X	X	—
Clean Drive	**Tools** > **Drive Mgmt** > **Clean drive**	X	—	—	**Manage Drives** > **Drive Summary** > **Clean**	X	X	—
Display Drive Information	**Tools** > **Drive Info**	X	X	X	**Service Library** > **View/Update Drive Firmware Levels**	X	O	—
Capture Drive Log	N/A				**Service Library** > **Capture Drive Log**	X	X	—

Table 4-3. System Functions, Commands, and Access (continued)

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
Fibre Channel Ports	**Setup** > **Drive Settings**	X	—	—	**Manage Drives** > **Fibre Channel Ports**	X	O	—
Reset Drive	N/A		X		**Service Library** > **Service Drives** > **Reset Drive**	X	X	—
Create FMR Tape	**Tools** > **Drive Mgmt** > **Create an FMR tape**	X	—	—	N/A			
Update Drive Firmware	**Tools** > **Drive Mgmt** > **Update drive firmware using FMR**	X	—	—	**Service Library** > **View/Update Drive Firmware Levels**	X	O	—
Erase FMR Tape	**Tools** > **Drive Mgmt** > **Erase an FMR tape**	X	—	—	N/A			
Media/Cartridges								
Move Data Cartridges	**Operations** > **Move Media**	X	—	X	**Manage Cartridges** > **Data Cartridges**	X	X	X
Insert Data Cartridges	**Operations** > **Insert Media**	X	X	X	**Manage Cartridges** > **I/O Station**	X	X	X
Remove Data Cartridges	**Operations** > **Remove Media**	X	X	X	**Manage Cartridges** > **Data Cartridges**	X	X	X
Cleaning Cartridges	**Operations** > **Insert Cleaning Media** and **Operations** > **Remove Cleaning Media**	X	X	X	**Manage Cartridges** > **Cleaning Cartridges**	X	X	X
Manage Cartridges in I/O Station	N/A				**Manage Cartridges** > **I/O Station**	X	X	X
Manual Cartridge Assignment	**Tools** > **System Settings** > **Manual Cartridge Assignment**	X	—	—	N/A			
System/Network Settings								
Network Configuration	**Setup** > **Network Mgmt** > **Network Configuration**	X	—	—	**Manage Library** > **Settings** > **Network**	X	O	—
Save/Restore Configuration	N/A				**Manage Library** > **Settings** > **Save/Restore Configuration**	X	—	—

Table 4-3. System Functions, Commands, and Access (continued)

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
Enable Internet Protocol ver. 6 (IPv6)	**Tools** > **System Settings** > **Enable IPv6** OR **Setup Wizard** (first time only)	X	—	—	**Manage Library** > **Settings** > **Network**	X	—	—
Date and Time	**Setup** > **Date & Time**	X	—	—	**Manage Library** > **Settings** > **Date & Time**	X	O	—
Network Time Protocol (NTP)	N/A				**Manage Library** > **Settings** > **Date & Time**	X	O	—
Trap and SNMP	N/A				**Manage Library** > **Settings** > **SNMP** and **Manage Library** > **Settings** > **SNMP Traps**	X	O	—
Control Path	**Setup** > **Control Path**	X	—	—	**Manage Drives** > **Control Paths**	X		—
Operator Intervention	**Tools** > **Operator Intervention**	X	X	—	**Service Library** > **Operator Interventions**	X	X	—
DNS Configuration	N/A				**Manage Library** > **Settings** > **Network**	X	O	—
Enter Contact Information	N/A				**Manage Library** > **Settings** > **Contact Information**	X	O	—
Set Email Notifications	N/A				**Manage Library** > **Settings** > **Email Notifications**	X	O	—
Diagnose/Test LME Key Paths	N/A				**Service Library** > **Key Path Diagnostics**	X	X	—
Internal Network Configuration	**Tools** > **Internal Network**	X	—	—	N/A			
Touch Screen Audio	**Tools** > **System Settings** > **Touch Screen Audio**	X	X	X	N/A			
Adjust Display	**Tools** > **Display Settings**	X	X	X	N/A			
Display System Summary	N/A				**Monitor System** > **System Summary**	X	X	X
Display Network Settings	N/A				**Monitor System** > **Network Settings**	X	X	X

Table 4-3. System Functions, Commands, and Access (continued)

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
Outgoing Server (Mail) Configuration	N/A				**Manage Library** > **Settings** > **SMTP (Mail) Configuration**	X	O	—
Ethernet Speed/Duplex Settings	N/A				**Manage Library** > **Settings** > **Ethernet Speed/ Duplex Settings**	X	O	—
Display License Key Status	N/A				**Manage Library** > **Settings** > **Feature Licenses**	X	X	—
Service								
Enter Service Menu	**Tools** > **Service**	X	—	—	N/A			
Service Drives	**Tools** > **Service** > **Drives**	X	X	—	N/A			
Service System	**Tools** > **Service** > **System**	X	X	—	N/A			
Security Settings	**Tools** > **Security**	X	—	—	N/A			

Function	Control Panel Menu Command and Access	A	S	U	Web UI Command and Access	A	S	U
Service User								
View Library Logs	**Tools** > **Library Tests**	X	—	—	N/A			
Email Logs	**Tools** > **Library Tests**	X	—	—	N/A			
Library Demo	**Tools** > **Library Tests**	X	—	—	N/A			
Reset to Factory Defaults	**Tools** > **Factory Defaults**	X	—	—	N/A			

Chapter 5. Service Action Tickets (Txxx) and Diagnostic Resolutions (DRxxx)

"Service Action Tickets"

"**Diagnostic Resolutions**" on page 5-59

Before you begin servicing the library, refer to "General Service Guidelines" on page 6-3.

Service Action Tickets

When the library detects a problem, it generates an error code and displays it in the Operator Intervention report, along with a full description of the problem and suggestions for resolving it.

The sections below offer more information than will be displayed in an Operator Intervention on the Operator Panel. Refer to this information for additional help in resolving problems.

Check your host for Sense Data and refer to "Drive Sense Data" on page B-6.

Important: It is recommended that Service Action Tickets not be allowed to accumulate in the Operator Intervention reports. After an incident has been resolved or repaired, the Service Action Ticket should be closed.

T001: Tape Cartridge Stuck in Picker, Motion OK

Description	GUI Description: A tape is stranded in the Picker Assembly and must be removed to continue operations. Explanation: The robot is not logically expecting to see a tape in the picker, but the tape presence sensor indicates otherwise. The tape cannot legitimately be returned to a home slot nor can it be placed in a destination slot. The volser may be unknown or the library may be full or changing the host(s) inventory is disruptive
Detection Scenarios	1. The Picker becomes enabled after a door is opened or the library system boots up and discovers that the cartridge present sensor detects a cartridge. 2. The system has tried to recover from a PUT failure and wants to return the cartridge to a home slot; however, the home slot recovery logic completes without recovery (home slot is a drive or the I/O Station is open or the I/O Station is full). 3. The cartridge present sensor and sensing circuit is falsely representing the presence of a cartridge.

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Root Causes	1. Operator did not recover cartridge. 2. Operator put a cartridge in the Picker. 3. Power loss during a move with media and the library logic cannot legitimately return it to the proper cell. 4. Physical contamination such as dust and debris on the sensor gives a "false full state". 5. Various electrical failures.
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit
Resolution	Perform “DR001: Resolve Picker Cartridge Presence” on page 5-59.

T002: PUT Operation Failed, Final Cartridge Position Unknown, Motion OK

Description	GUI Description: The robot failed to place a tape cartridge and cartridge recovery is required. Explanation: The library cannot successfully put a tape into a drive, storage slot, or I/O station and the final “resting place” of the tape is unknown. There are no additional recovery logic paths to be exercised. Fundamental servo control seems OK. If the operation was initiated by a host move media, the move media command has failed with a SK/ASC/ASCQ 4h/15h/01h (hardware mechanical positioning error).
Detection Scenarios	PUT is not successful, PUT recovery is not successful, and a cartridge is not known to be properly seated in the Picker or a storage slot.
Root Causes	1. Magazine is damaged. 2. Magazine is the wrong type for the cartridge. 3. A storage cell is blocked by foreign material or not clipped in and seated correctly. 4. Calibration problem resulted in improper Picker position. 5. Picker offset problem. 6. Cartridge is damaged. 7. Unlabeled cartridge or intermittently readable cartridge label in destination slot. 8. Drive load mechanism is not working. 9. A variety of Picker problems such as slipping gears, encoder issues, etc.
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit
Resolution	Perform “DR002: Resolve Tape Cartridge Recovery” on page 5-60.

T003: GET Operation Failed, Final Cartridge Position Unknown, Motion OK

Description	GUI Description: The robot failed to pick a tape cartridge and cartridge recovery is required. Explanation: The library cannot successfully get a tape from a drive, storage or I/O location. The final "resting place" of the tape is unknown. There are no additional recovery logic paths. Fundamental servo control appears to be OK. If the operation was initiated by a host move media, the move media command has failed with an ASC/ASCQ of 4h/15h/01h (hardware mechanical positioning error).
Detection Scenarios	GET is not successful, GET recovery is not successful, and the cartridge is not known to be properly seated in the Picker or a storage slot.
Root Causes	1. Magazine is damaged. 2. Magazine is the wrong type for the cartridge. 3. A storage cell is blocked by foreign material or not clipped in and seated correctly. 4. Calibration problem resulted in improper Picker position. 5. Picker offset problem. 6. Cartridge is damaged. 7. Unlabeled cartridge or intermittently readable cartridge label in destination slot. 8. Drive load mechanism is not working. 9. A variety of Picker problems such as slipping gears, encoder issues, etc.
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit
Resolution	Perform "DR002: Resolve Tape Cartridge Recovery" on page 5-60.

T004: PUT Operation Failed, Tape Back In Source Location, Motion OK

Description	GUI Description: The robot failed to place a tape cartridge to a destination slot but recovered the cartridge to an alternate location. Explanation: The library cannot successfully put a cartridge into the intended target drive, storage or I/O location. The library has successfully returned the cartridge to the source location. Fundamental servo control appears to be OK.
Detection Scenarios	PUT is not successful and PUT recovery is not successful at the destination element. Recovery logic has allowed the cartridge to be returned to the initial source location. If the operation was initiated by a host MOVE MEDIA, the MOVE MEDIA command has failed with a Sense Key/ASC/ASCQ of 4h/15h/01h.

Root Causes	1. Magazine is damaged, wrong type, cell is blocked by foreign material, or not clipped in and seated correctly. 2. Calibration problem. 3. Picker offset problem. 4. Destination cell full with labeled cartridge (invalid inventory). 5. Destination cell is full with cartridge that has damaged label or is unlabeled or has an intermittently readable label. 6. A variety of Picker problems such as slipping gears, encoder issues, Y-axis assembly not level, etc.
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit
Resolution	Perform "DR004: Resolve Full Destination Element" on page 5-61.

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T005: X, Y, Theta Motion Profile Failure, Tape in Picker, Motion NOT OK

Description	GUI Description: The robot failed to move a tape cartridge due to an axis motion problem. Explanation: Any X, Y, Theta (θ) motion failure occurred that cannot be considered a complete obstruction. This problem only occurs during a move and NOT a get or put. Because the tape is in the picker, tape recovery must be a part of the resolution strategy. This ticket cause specifically excludes any Z axis motion failures that are typically associated with get or put actions. Specifically included are motion failures that occur while pivoting, moving on the X-axis or moving on the Y-axis.
Detection Scenarios	1. A specified move in the X-axis cannot complete. 2. A specified move in the Y-axis cannot complete. 3. A specified movement in the Theta (θ)-axis cannot complete.
Root Causes	1. A large number of electrical hardware failures. Code or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuit issues, motor winding issues, cable connection issues, etc.). 2. A relatively small number of mechanical hardware errors that do not result in the detection of a complete obstruction but where motion control does not appear to be normal (contamination or damage to encoder wheel, high friction, etc).
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Robot Assembly • Cable Spool • Y Motor • Y-axis Assembly • Internal Cables and Boards Kit

Resolution	• Perform “DR001: Resolve Picker Cartridge Presence” on page 5-59 • Perform “DR005: Resolve Motion Failure” on page 5-62.

T006: X, Y, Theta Motion Profile Failure, No Tape In Picker, Motion NOT OK

Description	GUI Description: The robot failed to move due to an axis motion problem. Explanation: An unrecoverable motion failure occurs at an operational point where a cartridge is not in the Picker. Because the cartridge is not in the Picker, cartridge recovery is not necessary as part of the resolution to this issue. This cause specifically excludes any Z-axis motion failures. Specifically included are motion failures that occur while pivoting, moving on the X-axis or moving on the Y-axis. If the ticket details indicate that the Y-axis has problems, then both the picker and the Y-carriage assembly should be replaced. Otherwise, only the picker should be replaced..
Detection Scenarios	1. A specified move in the X-axis cannot complete. 2. A specified move in the Y-axis cannot complete. 3. A specified movement in the Theta (θ)-axis cannot complete.
Root Causes	1. A large number of electrical hardware failures. Code or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuit issues, motor winding issues, cable connection issues, etc.). 2. A relatively small number of hardware errors that do not result in complete obstruction but where servo control does not appear to be normal.
Possible CRU Replacements	• Tape Cartridge • Library Control Blade
Possible FRU Replacements	• Robot Assembly • Cable Spool • Y Motor • Y-axis Assembly • Internal Cables and Boards Kit
Resolution	Perform “DR005: Resolve Motion Failure” on page 5-62.

T007: X, Y, Theta Motion Obstruction, Motion OK

Description	GUI Description: The robot is unable to properly move due to an obstruction in its motion path. Explanation: A complete physical obstruction exists in a motion path that precludes repeated attempts to move beyond a certain point in the range of motion. Servo control appears normal but a move profile cannot be completed. Cartridge may have been returned to a home slot.
Detection Scenarios	1. A specified move in the X-axis cannot complete but motion control appears normal. 2. A specified move in the Y-axis cannot complete but motion control appears normal. 3. A specified move in the Theta (θ)-axis cannot complete but motion control appears normal.

Root Causes	1. Operator Intervention that results in foreign material or an obstructing object in a library motion path. 2. Picker locking mechanism left engaged in the library motion path (see Figure 7-1 on page 7-5) . 3. Certain damaged hardware conditions that obstruct motion at a particular point along an axis.
Possible CRU Replacements	Tape Cartridge
Possible FRU Replacements	• Robot Assembly • Y-carriage Assembly
Resolution	• Verify that no obstructions are present in the path of the Picker. • Perform “DR028: Resolve Motion Obstruction” on page 5-71.

T008: Cannot Home, Motion OK

Description	GUI Description: The robot can move but cannot establish its home position correctly. Explanation: Robot motion and servo control appear normal but home sensors do not transition when the robot is moved through prescribed search distances and times.
Detection Scenarios	1. X home sensor does not transition while homing. 2. Y home sensor does not transition while homing. 3. θ home sensor does not transition while homing. 4. Z home sensor does not transition while homing.
Root Causes	1. Malfunctioning home sensors. 2. Missing or damaged mechanical flags that trigger home sensors (see Figure 3-11 on page 3-8). 3. Hardware failures that result in apparent normal motion according to encoders, but no actual motion (ex. slipping gears). 4. Robot parking tab is interfering with Y-axis travel of the robot. 5. Robot assembly is not placed properly into Y-climber rails, resulting in an unleveled robot when moving along the Y-rails. 6. Y-rails are not secured correctly, causing the robot Y-carriage to become unleveled when moving between modules.
Possible CRU Replacements	• Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y Motor • Y-axis Assembly • Internal Cables and Boards Kit
Resolution	• Verify that no obstructions are present in the path of the Picker. • Perform “DR028: Resolve Motion Obstruction” on page 5-71.

T009: Drive Load Unsuccessful, Motion OK

Description	GUI Description: An attempted drive load failed, but robotic motion appeared normal. Explanation: The robot has successfully completed all motion profiles associated with putting to a drive but the drive reports that the tape cartridge did not load.
Detection Scenarios	While checking the status of a drive after a PUT motion profile to the drive is completed, the drive does not report back a loaded state.
Root Causes	1. Defective drive. 2. Defective tape cartridge. 3. Motion profile was successful as detected at motor encoders but cartridge did not get placed far enough. 4. Picker dragged cartridge back out of drive but not far enough to trigger Picker cartridge present sensor.
Possible CRU Replacements	• Tape Cartridge • Drive Sled
Possible FRU Replacements	• Picker Assembly
Resolution	Perform "DR030: Resolve Drive Load Failure" on page 5-72.

T010: Drive Unload Failed

Description	GUI Description: A drive did not eject a tape. Explanation: The library is expecting the drive to achieve an unloaded state but the drive does not.
Detection Scenarios	1. After being issued a move media from a host that requires a get from a tape drive, the tape drive never achieves the unloaded state. 2. When GUI commands are issued that require a drive unload (manual drive unload, move media, etc.) and the drive never achieves the unloaded state. **Note:** This ticket cause will interact with "explicit unload" behavior. Since the library will always issue an unload command, it is not possible to determine if a host unload command failed first followed by a subsequent failure of a library issued unload command.
Root Causes	1. Drive is still busy with host application command execution. 2. Tape drive fails to unload after the library issues an unload command. 3. Defective tape cartridge.
Possible CRU Replacements	• Tape Cartridge • Drive Sled
Resolution	Perform "DR003: Resolve Drive Eject Failure" on page 5-61.

T011: Drive Over Eject Condition

Description	GUI Description: A drive over-ejected a tape cartridge into the robot's motion path. Explanation: The library is about to perform a get from a tape drive and checks the tape drive status to determine if the tape cartridge is ejected. LTO tape drives have demonstrated a specific failure mode where they eject a tape in an abnormal manner. Normally upon eject, the tape is in a particular position where it is clear of the robot motion path and it cannot be reloaded due to mechanical interlock within the tape drive load mechanism. The historical failure mode is that the tape slips an additional amount out of the tape drive throat which re-arms the load mechanism of the tape drive. Two subsequent problems can occur. The over ejected tape can become an obstruction hazard for robot moves. In addition, the robot get operations can then re-trigger the tape drive load mechanism by bumping the tape during a get. There can be a “tug of war” between robot and tape drive or the tape drive can win the tug of war resulting in the loading of a phantom tape. When the tape drive loads a phantom tape, there are resulting tape drive errors. The goal of reporting this problem is to identify tape drives that over eject tapes to avoid the two types of problems.
Detection Scenarios	Library checks drive status prior to moving to perform a GET. If is trying to determine if the drive is in an unloaded state and if a cartridge is present. If a cartridge is not reported as present, the library can assume it was "over ejected".
Root Causes	The drive eject process did not result in the proper positioning of the ejected cartridge.
Possible CRU Replacements	Drive Sled
Resolution	Perform the following: 1. “Removing a Drive Sled” on page 7-42. 2. “Replacing a Drive Sled” on page 7-43.

T012: Drive Unload Control Prevented

Description	GUI Description: A host issued a SCSI Prevent/Allow Media Removal command which is preventing the drive from unloading a tape cartridge. Explanation: The library needs to issue a command to the drive (such as unload) but cannot perform the operation, because the host issued a Prevent/Allow Medium Removal SCSI command, preventing media removal.
Detection Scenarios	1. Library tries to issue an unload command. 2. Library tries to issue a command associated with drive unload.
Root Causes	A host is either properly or improperly reserving the drive while a user or host is trying to properly or improperly perform some action on the drive.
Possible FRU Replacements	No library FRU is involved. Rather this is an indication that a host may have orphaned a reserve on the drive.
Resolution	Perform “DR016: Resolve Prevent/Allow Media Removal” on page 5-67.

T013: Invalid Library SN Label, Library Cannot Initialize

Description	GUI Description: A library module serial number label cannot be read, preventing the library from proper initialization and operation. Explanation: The library logic learns the serial number of the system by reading an internal serial number label. This is done at first bootup from a “cleared to ship” condition in order to establish the serial number. It is also done on subsequent bootups to confirm that the LCB Compact Flash memory card is in the proper library. The library will report a problem when it cannot read a serial number or detects an invalid serial number or another barcode on the module label when in this "cleared to ship" condition. When T013 is posted, the library cannot operate normally. Different tickets will be posted if there are motion-related problems, scanner communication problems, etc.
Detection Scenarios	1. At first power ON during installation, the library must establish the serial number for the first time. There may be no serial number in system memory at this point. 2. At any power up, system memory already has a serial number established for the Library Control Blade. 3. A Library Control Blade is improperly swapped into a different physical library and the system reads the physical library label.
Root Causes	1. Library Control Blades swapped between libraries. 2. Label is damaged, misaligned, or placed on the cartridge incorrectly. 3. Bar code scanner not working properly. 4. Entire communication path to bar code scanner is not working properly.
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	• Picker Assembly • Y Motor • Y-axis Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit **Note:** The system serial number label is part of the enclosure FRU.
Resolution	.

T014: I/O Station Magazine Missing

Description	GUI Description: A library I/O station has been closed with a magazine missing. Explanation: There is a fixed bar code label location on the I/O Station structure behind the removable magazines. It decodes as %XXX. The purpose of the label is to allow the library to detect that an I/O Station magazine is not installed. This is important on I/O Station magazines, because they are user removable. While performing an inventory of the I/O Station magazines, the library ends up verifying the presence of the magazine by NOT detecting this special fixed label.
Detection Scenarios	Any time the library attempts to inventory an I/O Station magazine, it will read the fixed label if a magazine is missing. I/O Station magazines are always expected to be present.

Root Causes	1. Missing I/O Station magazine 2. A cartridge in an I/O Station just happens to have a label that decodes as "%XXX". **Note:** The inability to communicate between the Library Control Blade and the bar code scanner should result in a different ticket cause.
Resolution	Perform "DR023: Resolve Missing I/O Station Magazine" on page 5-69.

T015: Drive Sled Fiducial Read Failure

Description	GUI Description: The robot is unable to scan the drive sled's identification/fiducial label. Explanation: When the library is attempting to determine the type of a drive and verify its physical presence in the library, it cannot do so because it cannot read a label where it expects to find one.
Detection Scenarios	1. Installation of a drive into a library drive slot triggers the library to discover it. 2. Boot up causes the library to physically discover any drive that is electrically connected in the system.
Root Causes	1. Damaged label or marginal label that cannot be read 2. Drive with invalid label is present (earlier generation of plug compatible drive sled) **Note:** The inability to communicate between the Library Control Blade and the bar code scanner should result in a different ticket cause.
Possible CRU Replacements	Drive sled
Resolution	Perform "DR007: Resolve Barcode Scanner Issue" on page 5-63.

T016: Unexpected Drive Type

Description	GUI Description: A configured drive sled has been replaced with a drive sled of different type. . Explanation: When the library is attempting to determine the type of a drive and verify its physical presence in the library, it detects a drive type that is not compatible with the logical library assignment of the drive slot (for example, an LTO-1 drive in an LTO-3 drive position).
Detection Scenarios	1. Installation of a tape drive into a library drive slot triggers the library to discover it. 2. Bootup causes the library to physically discover any tape drive that is electrically connected in the system.
Root Causes	1. End user or CE mistakenly uses the actual wrong type of CRU (for example, LTO-1 drive sled in a slot defined as LTO-3). 2. Manufacturing defect has wrong label type for actual physical drive type (for example, LTO-1 label on an LTO-3 drive). **Note:** Inability to communicate between the LCB and the scanner should result in a different ticket cause.
Possible CRU Replacements	Drive sled

Resolution	Perform the following: 1. "Removing a Drive Sled" on page 7-42 2. "Replacing a Drive Sled" on page 7-43

T017: Invalid Storage or I/O Position

Description	Calibration completes and the coordinates of each storage and I/O element are calculated. The calculated values are determined to be outside travel limits that have been established for the robot.
Detection Scenarios	Calculated element positions fail validity check against travel limits.
Root Causes	1. Calibration targets not in position. 2. Calibration sensor detects edges but is not correctly finding calibration target edges.
Possible FRU Replacements	• Fiducial targets • Storage Column • Y Motor • Y-axis Assembly • Y-axis Cable Spool • Picker Assembly • Internal Cables and Boards Kit
Resolution	If the problem can not be resolved using the information in this document, perform "DR021: Contact IBM Service" on page 5-68

T018: Invalid Drive Position

Description	Calibration completes and the coordinates of each drive are calculated. The calculated values are determined to be outside travel limits that have been established for the robot.
Detection Scenarios	Calculated element positions fail validity check against travel limits.
Root Causes	1. Drive calibration target is not in position. 2. Calibration sensor detects edges but is not correctly finding calibration target edges.
Possible CRU Replacements	Drive Sled
Possible FRU Replacements	• Y Motor • Y-axis Assembly • Picker Assembly • Y-axis Cable Spool • Internal Cables and Boards Kit
Resolution	If the problem can not be resolved using the information in this document, perform "DR021: Contact IBM Service" on page 5-68

T019: Drive Calibration Failure, Motion OK

Description	GUI Description: The library is unable to calibrate the position of a drive. Explanation: System electrically detects a drive and is able to scan the bar code label but cannot successfully calibrate the position of the drive. The calibration search pattern completes successfully.
Detection Scenarios	Calibration motion completes but edge finding of one or more edges does not occur.
Root Causes	1. Damaged drive sled calibration fiducial. 2. Dust on picker assembly calibration sensor. 3. Calibration sensor not functioning properly. 4. Drive or Picker position is so far off nominal that search pattern cannot locate target.
Possible CRU Replacements	Drive Sled
Possible FRU Replacements	• Y Motor • Y-axis Assembly • Y-axis Cable Spool • Picker Assembly • Internal Cables and Boards Kit
Resolution	1. Perform “DR082: Resolve Library Calibration Failure” on page 5-84. 2. Use the 'Details' option in the RAS ticket to identify which tape drive is having trouble being calibrated. Reseat the drive sled in another sled bay. 3. Reseat the picker and Y-climber to ensure they are level. 4. Clear the RAS ticket and retry the original operation.

T020: Storage Calibration Failure, Motion OK

Description	GUI Description: The library is unable to calibrate the position of a tape cartridge magazine. Explanation: System cannot successfully calibrate the position of a storage magazine but the calibration search pattern completes successfully.
Detection Scenarios	Calibration motion completes but edge finding of one or more edges does not occur.
Root Causes	1. Dust on picker assembly calibration sensor. 2. Calibration sensor not functioning properly. 3. Calibration target not functioning properly. 4. Fiducial target or robot position is so far off nominal that search pattern cannot locate target (i.e., unlevel picker). This can also generate a T083: Picker Assembly not level.
Possible FRU Replacements	• Column Assembly • I/O Slide Assembly

Resolution	1. Perform "DR082: Resolve Library Calibration Failure" on page 5-84. **Note:** The picture shown in DR082 shows the location of the calibration sensor. If you are guiding a customer by phone, you may want to copy the picture and e-mail it to them. 2. Open the doors on the all the modules in the library from the bottom to the control module. Lift up the robot and bring it to rest on the parking tab. Check inside the library for any debris on the floor of the library that would interfere with picker movement. 3. Remove the robot from the library and carefully inspect the picker for any damage or obstruction on the face that would prevent a clear line of sight to the barcodes or fiducials. Place the robot back into the library. Ensure that the Y-rails are locked in the down position and that the robot is level. Close this ticket and resume normal operations. If this ticket reoccurs, to go the next step. 4. Clear the RAS ticket and retry the original operation.

T021: Drive Sled Communication Failure

Description	GUI Description: The library has lost communication with the drive sled. Explanation: The library had been communicating with a tape drive sled and had considered it to be assigned to a logical library. Two-way communications no longer occur. This ticket is specifically NOT caused by two scenarios: • Physical removal of a tape drive if the tape drive is not assigned to a logical library • Complete physical removal of a drive if it is turned offline via the library operator panel When the library detects loss of communication with a drive that is online, the library robot attempts to scan the barcode label on the drive. If the label is read and communication is not present, the ticket gets posted based on the fact that the drive is physically present but no communication is occurring. If the label is not read, the drive is assumed to be physically removed and therefore communication should not be expected.
Detection Scenarios	1. Routine polling of the sled can no longer occur. 2. Specific library to drive sled commands are not responded to.
Root Causes	1. Drive is physically remove/unplugged (intentional or never installed correctly). 2. Various hardware failures on the drive sled. 3. Various hardware failures in the library.
Possible CRU Replacements	• Module Terminators and Module-to-Module Cables • Drive Sled
Possible FRU Replacements	• Internal Cables and Boards Kit • Expansion Module Chassis
Resolution	Perform "DR029: Resolve Drive Sled Communication Loss" on page 5-71.

T022: Tape Drive Communication Failure

Description	GUI Description: Communication to the tape drive has failed inside the drive sled assembly. Explanation: Internal to the drive, the sled control board can no longer communicate with the drive brick.
Detection Scenarios	1. Routine Polling between sled control board and drive brick can no longer occur. 2. Specific commands such as unload, reset, etc. are not responded to.
Root Causes	1. Cable broken, unplugged, damaged, etc. 2. Drive brick failure.
Possible CRU Replacements	Drive Sled
Resolution	Clear the operator intervention. If the library firmware is below 400G, upgrade the library firmware to 400G or later revision of code. A timing issue was addressed in the 400G library firmware which was occasionally falsely reporting T022 operator interventions. If the library firmware is at 400G or later, or the problem persists after upgrading to 400G or later revision code, perform the following steps. Perform the following: 1. “Removing a Drive Sled” on page 7-42 2. “Replacing a Drive Sled” on page 7-43

T023: Drive Sled Fan Failure

Description	GUI Description: The fan within the drive sled assembly is spinning too slowly or does not rotate at all.
Detection Scenarios	Regular polling/monitoring of the fan indicates a problem.
Root Causes	1. Hardware failure of fan. 2. Wiring or PCBA failure. 3. Blocked air paths. 4. Physical obstruction.
Possible CRU Replacements	Drive Sled
Resolution	Perform the following: 1. “Removing a Drive Sled” on page 7-42 2. “Replacing a Drive Sled” on page 7-43 3. Use the 'Details' option in the RAS ticket to identify which tape drive is generating the RAS ticket. If possible, check the front of the tape drive for error indications. Check the suspect drive sled to determine if the fan is still spinning. Check for any obstructions.

T024: AC Power Loss

Description	GUI Description: AC power to a library power supply has been turned off. Explanation: A power supply has detected loss of AC power. AC power loss to a single power supply control module is unlikely to be able to post this ticket due to the speed at which system shut down occurs after an AC loss. This Ticket is most likely to occur when there is AC loss to a redundant power supply in a control module or any supply in any expansion module.

Detection Scenarios	AC power status from the supply creates an interrupt that is managed by software.
Root Causes	1. AC supply is gone (cord removed, customer side AC failure, etc.). 2. Individual on/off switch for the supply has been set to off. 3. Hardware failure inside supply.
Possible CRU Replacements	• Power Supply • Expansion Module
Possible FRU Replacements	Internal cables and boards kit
Resolution	Perform the following: • "DR009: Resolve AC Failure" on page 5-63

T025: Power Supply Hardware Failure

Description	GUI Description: A defective power supply has been detected. Explanation: Power supplies report four failure conditions that are considered to be a hardware failure within the supply: Fan Fail, Over Temp, DC Fail and Over Current. These failures can occur in both single and redundant power supply control modules and any expansion module with a power supply.
Detection Scenarios	Regular polling between Library Control Blade and power supply is not successful.
Root Causes	1. Detected fan failure in the supply. 2. Detected over temp condition in the supply. 3. Detected DC failure in the supply. 4. Detected over current failure in the supply.
Possible CRU Replacements	• Power Supply • Module Terminators and Module-to-Module Cables
Possible FRU Replacements	Internal Cables and Boards Kit
Resolution	Before performing any remove/replace procedures, refer to Chapter 1, "Start Service," on page 1-1 for additional diagnostic procedures.

T026: Primary Key Server Failover

Description	GUI Description: The library performed a successful communication failover to the secondary key server. Explanation: The Key Management feature of this library allows the user to connect 2 key servers for redundancy. If communication to the primary server is interrupted, the library will automatically switch or failover to the secondary server. This RAS ticket will be generated to notify the user of this failover event.
Detection Scenarios	• When the library detects that it can no longer communicate with the primary key server and automatically switches to the secondary key server.
Root Causes	1. Primary Key Server is not connected properly. 2. Primary Key Server is not configured properly. 3. Library Ethernet settings are not configured properly.

Resolution	1. Perform “DR079: Resolve Key Server Communication Issue” on page 5-83. 2. Perform EKM Path Diagnostics (**Tools** > **Diagnostics** > **EKM** > **EKM Path Diagnostics** in the Web User Interface). 3. If the "Ping" test is unsuccessful, look for physical connection problems and down server(s). 4. If "Ping" is successful, then do the following: a. Verify that EKM is running. b. Verify that the media is not from a different EKM environment. c. Verify that the key server is present. .

T027: Key Server Communication Failure

Description	GUI Description: The library is unable to communicate with the configured key server(s). Explanation: The key management feature of the library allows the user to connect to two key servers for redundancy. If communication to one of these servers fails and a communication failover is not possible or not successful, then this ticket will be generated. A separate ticket will be created for each key server that fails..
Detection Scenarios	Library detects that communication with a key server is not successful
Root Causes	1. Primary/Secondary Key Server is not connected properly. 2. Primary/Secondary Key Server is not configured properly. 3. Library Ethernet settings are not configured properly.
Resolution	1. Perform “DR079: Resolve Key Server Communication Issue” on page 5-83. 2. Perform EKM Path Diagnostics (**Tools** > **Diagnostics** > **EKM** > **EKM Path Diagnostics** in the Web User Interface). 3. If the "Ping" test is unsuccessful, look for physical connection problems and down server(s). 4. If "Ping" is successful, then do the following: a. Verify that EKM is running. b. Verify that the media is not from a different EKM environment. c. Verify that the key server is present.

T028: Secondary Key Server Failover

Description	GUI Description: The library performed a successful communication failover to the primary key server. Explanation: The key management feature of the library allows the user to connect two key servers for redundancy. If communication to the secondary server is interrupted, then the library will automatically switch or failover to the primary server. This RAS ticket will be generated to notify the user that communication to the secondary key server failed and that the library performed a successful failover to the primary key server.
Detection Scenarios	When the library detects that it can no longer communicate with the secondary key server and automatically switches to the primary key server where it established successful communication.

Root Causes	1. Secondary Key Server is not connected properly. 2. Secondary Key Server is not configured properly. 3. Library Ethernet settings are not configured properly.
Resolution	1. Perform "DR079: Resolve Key Server Communication Issue" on page 5-83. 2. Perform EKM Path Diagnostics (**Tools** > **Diagnostics** > **EKM** > **EKM Path Diagnostics**in the Web User Interface).

T029 - Key Server Communication Warning

Description	The library is unable to successfully monitor the communication path and operation status of the configured key server. The key management feature of the library allows the user to connect two key servers for redundancy. If communication fails during background key server path testing, this operator intervention will be generated. A separate operator intervention will be created for each key server that fails.
Detection Scenarios	Library detects that communication with a key server is not successful
Root Causes	1. Primary/secondary key server is not connected properly 2. Primary/secondary key server is not configured properly 3. Library Ethernet settings are not configured properly
Resolution	1. Perform "DR079: Resolve Key Server Communication Issue" on page 5-83. 2. Perform Key Path Diagnostics (**Service Library** > **Key Path Diagnostics** in the Web User Interface).

T030: Excessive I/O Station Events

Description	GUI Description: An I/O station is reporting continuous door open or closure events although no close or open door state change is detected.. Explanation: The library controller is receiving too many I/O station interrupts. The problem may be caused by a stuck interrupt line for the CM or EM door open and close indication. Door open and close state changes are detected properly, but the excessive I/O station state change interrupt notifications indicate a hardware problem, most likely due to a cabling/connection issue.
Detection Scenarios	Library firmware receives multiple or continuous I/O station open and close interrupts, but does not detect the required door open and close state change.
Root Causes	1. Internal module sensor line and cable connections shorted. 2. Module terminator pins bent or shorted. 3. Module-to-module cable pins bent or shorted.
Resolution	1. Perform "DR008: Resolve Stuck I/O Station Interrupt" on page 5-63. 2. Inspect the module terminators and module-to-module cables for loose connectors or damage (bent or broken pins). If damaged, replace the part. Reseat the terminators and cables. 3. Power on the library and wait for the library to initialize. Open and close each I/O station door. If the problem is not fixed you may need to replace the module.

Possible Replacement CRUs/FRUs	1. Module Terminators and Module-to-Module Cables 2. Module (EM or CM)

T031: I/O Station Unlock Failure

Description	GUI Description: A I/O station lock failed to unlock. Explanation: System logic or external command is requiring I/O station lock to unlock but it will not.
Detection Scenarios	When unlock action is attempted, lock/unlock position sensor does not detect the proper state.
Root Causes	1. Lock mechanism not working properly. 2. Lock position sensor not working properly. 3. Mechanical binding or obstruction prevents proper motion and detection. 4. Mechanical failure of sensor flag.
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	• I/O Station Lock Assembly • Display/Door and I/O PCB • Internal Cables and Boards Kit
Resolution	Perform the following: • "DR011: Resolve I/O Station Lock/Unlock Failure" on page 5-64 • "Replacing the I/O Station Lock Assembly" on page 7-36

T032: I/O Station Lock Failure

Description	GUI Description: A I/O station lock failed to lock when required. Explanation: System logic or external command is requiring I/O station lock to lock but it will not.
Detection Scenarios	When a lock action is attempted, the lock/unlock position sensor does not detect the proper state.
Root Causes	1. Lock mechanism not working properly. 2. Lock position sensor not working properly. 3. Mechanical binding or obstruction prevents proper motion and detection. 4. Mechanical failure of sensor flag.
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	• I/O Station Lock Assembly • Display/Door and I/O PCB • Internal Cables and Boards Kit
Resolution	Perform the following: • "DR011: Resolve I/O Station Lock/Unlock Failure" on page 5-64 • "Replacing the I/O Station Lock Assembly" on page 7-36

T033: Drive TapeAlert Flag 3 - Hard read or write error

Description	System determines that the drive has issued a TapeAlert 3 indicating an unrecoverable read, write or positioning error.
Detection Scenarios	Tape drive issues a Tape Alert 3 which is recognized by the library during the continuous 4 second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	• Cartridge • Drive Sled
Resolution	If the cartridge is managed by a host application, remove the cartridge via the host application. If the cartridge is managed by the library, perform the following: • Remove the suspect cartridge (To remove a data cartridge using the Operator Panel, select **Operations** > **Remove Media**. To remove a cleaning cartridge using the Operator Panel, select **Operations** > **Remove Cleaning Media**. To remove a data cartridge using the Web User Interface, select **Manage Cartridges** > **Data Cartridges**. To remove a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.). • Insert a new cartridge (To insert a data cartridge using the Operator Panel, select **Operations** > **Insert Media**. To insert a cleaning cartridge using the Operator Panel, select **Operations** > **Insert Cleaning Media**. To insert a data cartridge using the Web User Interface, select **Manage Cartridges** > **I/O Station**. To insert a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.).

T034: Drive TapeAlert 4 - Media Error

Description	GUI Description: A tape can no longer be written or read or performance is severely degraded. Explanation: System determines that the drive has issued a TapeAlert 4 indicating an unrecoverable read, write or positioning error that the drive specifically isolates to the media. This ticket is generated only if accompanied by TA 39, to indicate a pulled leader pin.
Detection Scenarios	Tape drive issues a TapeAlert 4 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR044: Resolve Drive TapeAlert 4 - Media Error” on page 5-77

T035: Drive TapeAlert Flag 5 - Read Failure

Description	GUI Descriptiton: The drive is having difficulty reading from a tape. Explanation: System determines that the drive has issued a TapeAlert 5 indicating an unrecoverable read error where isolation is uncertain between drive and media.
Detection Scenarios	Tape drive issues a TapeAlert 5 which is recognized by the library during the continuous 4 second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.

Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR045: Resolve Drive TapeAlert 5, 6 - Read/Write Failure” on page 5-77.

T036: Drive TapeAlert Flag 6 - Write Failure

Description	GUI Description: The drive can no longer write data to a tape. Explanation: System determines that the drive has issued a TapeAlert 6 indicating an unrecoverable write error where isolation is uncertain between drive and media.
Detection Scenarios	Tape drive issues a TapeAlert 6 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR045: Resolve Drive TapeAlert 5, 6 - Read/Write Failure” on page 5-77.

T037: Drive TapeAlert Flag 8 - Not Data Grade

Description	GUI Description: The drive cannot use a tape because it is not of required data grade. Explanation: System determines that the drive has issued a TapeAlert 8 indicating that the tape cartridge in the drive is not a data grade tape.
Detection Scenarios	Tape drive issues a TapeAlert 8 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR046: Resolve Drive TapeAlert 8 - Suspect Data Grade Tape” on page 5-78.

T038: Drive TapeAlert Flag 9 - Write Protected

Description	GUI Description: The drive was requested to write to a write-protected tape. Explanation: System determines that a write was attempted on a write protected tape.
Detection Scenarios	Tape drive issues a TapeAlert 9
Root Causes	Write protect feature on tape is protecting the tape but the user is trying to write to it.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR014: Resolve Write-Protected Tape Cartridge” on page 5-66.

T039: Drive TapeAlert 12 - Unsupported Format

Description	GUI Description: The tape cartridge format is incompatible with the drive. Explanation: System determines that the drive has issued a TapeAlert 12 indicating that the media loaded is an unsupported format. In the case of the IBM LTO family of drives, full backward read and write compatibility stopped when LTO 3 was introduced. LTO 3 cannot write in LTO 1 format. Therefore an LTO 1 tape is an unsupported format when trying to write to it with an LTO 3 drive.
Detection Scenarios	Tape drive issues a TapeAlert 12 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR015: Resolve Unsupported Tape Format” on page 5-66.

T040: Drive TapeAlert 15 - MIC Chip Failure

Description	GUI Description: The memory in the tape cartridge has failed. Explanation: System determines that the drive has issued a TapeAlert 15 indicating that MIC (memory in cassette) of the media loaded is not working properly. The MIC is the memory that is part of the cartridge, also called LTO CM.
Detection Scenarios	Tape drive issues a TapeAlert 15 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR047: Resolve Drive TapeAlert 15 - Cartridge Memory Failure” on page 5-78

T041: Drive TapeAlert 16 - Forced Eject

Description	GUI Description: The tape has been ejected from a drive while it was being read or written. Explanation: System determines that the drive has issued a TapeAlert 16 indicating that an unload of a drive was triggered while the drive was actively reading or writing. The source of the unload can be either an operator initiated manual push button on the drive itself or a GUI initiated command.
Detection Scenarios	Tape drive issues a TapeAlert 16 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR048: Resolve Drive TapeAlert 16 - Forced Eject” on page 5-78.

T045: Drive TapeAlert 20 - Clean Now

Description	GUI Description: The drive is requesting cleaning before it can be used again. Explanation: System determines that the tape drive has issued a TapeAlert 20 indicating that the tape drive requires cleaning before it can be used again. This should be coincident with a "C" on the drive seven segment display.
Detection Scenarios	Tape drive issues a TapeAlert 20 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	No library CRU or FRU is involved. Rather, this is an indication that the tape drive requires a cleaning tape to continue. Use a known good cleaning tape to clean the tape drive.
Resolution	Perform “DR018: Resolve Drive Cleaning Requirement” on page 5-67.

T046: Drive TapeAlert 21 - Clean Periodic

Description	GUI Description: The drive is requesting cleaning at the next convenient opportunity. Explanation: System determines that the drive has issued a TapeAlert 21 indicating that the drive requires cleaning. This should be coincident with a "C" on the drive seven segment display..
Detection Scenarios	Tape drive issues a TapeAlert 21 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that a normal cleaning cycle has occurred.
Possible CRU Replacements	No library CRU or FRU is involved. Rather, this is an indication that the tape drive requires a cleaning tape to continue. Use a known good cleaning tape to clean the tape drive.
Resolution	Perform “DR018: Resolve Drive Cleaning Requirement” on page 5-67.

T047: Drive TapeAlert 22 - Expired Cleaning Media

Description	GUI Description: The cleaning tape has been used too many times. Explanation: System determines that a cleaning media is expired.
Detection Scenarios	• Tape drive issues a TapeAlert 22 • Code that manages library based cleaning determines that a cartridge is consumed based on actively managing the use count.
Root Causes	Cleaning tape is used up.
Possible CRU Replacements	No library CRU or FRU is involved. Rather, this is an indication that the cleaning tape media is expired and needs to be replaced.

Resolution	If the cartridge is managed by a host application, export the cartridge via the host application. If the cartridge is managed by the library, perform the following: • Remove the suspect cartridge (To remove a cleaning cartridge using the Operator Panel, select **Operations** > **Remove Cleaning Media**. To remove a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.). • Insert a new cartridge (To insert a cleaning cartridge using the Operator Panel, select **Operations** > **Insert Cleaning Media**. To insert a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.).

T048: Drive TapeAlert 23 - Invalid Cleaning Tape

Description	GUI Description: The tape drive requires cleaning, but a non cleaning tape was loaded. Explanation: System determines that the drive has issued a TapeAlert 23 indicating that the drive was expecting a cleaning tape but the loaded cartridge is not a cleaning tape.
Detection Scenario	Tape drive issues a TapeAlert 23 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	• User or library attempts to mount a cleaning tape but the tape is not actually a cleaning tape. • User mistakenly loads a data tape as a cleaning tape • Inventory or application issue results in data tape being loaded when drive expects cleaning tape
Possible CRU Replacements	• Tape Cartridge
Resolution	If the cartridge is managed by a host application, export the cartridge via the host application. If the cartridge is managed by the library, perform the following: • Remove the suspect cartridge (To remove a cleaning cartridge using the Operator Panel, select **Operations** > **Remove Cleaning Media**. To remove a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.). • Insert a new cartridge (To insert a cleaning cartridge using the Operator Panel, select **Operations** > **Insert Cleaning Media**. To insert a cleaning cartridge using the Web User Interface, select **Manage Cartridges** > **Cleaning Cartridges**.).

T049: Drive TapeAlert 30 - Hardware A

Description	GUI Description: The tape drive detected an internal hardware problem. Explanation: System determines that the drive has issued a TapeAlert 30 indicating a hardware error that requires a drive power cycle before the drive might recover to a usable state.
Detection Scenario	Tape drive issues a TapeAlert 30 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Drive Sled

Resolution	Before performing the following: • "Removing a Drive Sled" on page 7-42. • "Replacing a Drive Sled" on page 7-43. refer to Chapter 1, "Start Service," on page 1-1 for additional diagnostic procedures. • Perform "DR049: Resolve Drive TapeAlert 30, 31 - Drive Hardware Error" on page 5-79. • From the Operator Panel, select **Tools** > **Service** > **Drives** to run the drive diagnostic. A blank, scratch cartridge is required for this test.

T050: Drive TapeAlert 31 - Hardware B

Description	GUI Description: The tape drive detected an internal hardware problem. Explanation: System determines that the drive has issued a TapeAlert 31 indicating a hardware error that requires a drive power cycle before the drive might recover to a usable state.
Detection Scenario	Tape drive issues a TapeAlert 31 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Drive Sled
Resolution	• Perform "DR049: Resolve Drive TapeAlert 30, 31 - Drive Hardware Error" on page 5-79. • From the Operator Panel, select **Tools** > **Service** > **Drives** to run the drive diagnostic. A blank, scratch cartridge is required for this test.

T051: Drive TapeAlert 32 - Interface

Description	GUI Description: The tape drive reported an external data interface problem Explanation: System determines that the drive has issued a TapeAlert 32 indicating a tape drive has detected a problem with the application client interface.
Detection Scenarios	Tape drive issues a TapeAlert 32 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacements	Drive Sled(only if all cables are OK and host communication to other drives works)
Resolution	1. Perform "DR012: Resolve Drive Tape Alert 32 - Host Interface" on page 5-65. 2. Use the "Details" option in the RAS ticket to identify which tape drive reported the RAS ticket. 3. Clear the RAS ticket. 4. Check the cabling from the back of the tape drive to the host and reseat all the cables. 5. If RAS ticket persists, swap cables between drives to isolate a bad cable. If this works and you can detect the drive, replace the bad cable. 6. If swapping cables did not fix the problem, then upgrade the tape drive to the latest drive firmware.

T052: Drive TapeAlert 33 - Media Eject Required

Description	GUI Description: The tape drive has an error which requires the tape cartridge to be ejected for error recovery. Explanation: System determines that the drive has issued a TapeAlert 33 indicating that the drive requires a cartridge to be ejected in order to resolve a problem.
Detection Scenarios	Tape drive issues a TapeAlert 33 which is recognized by the library during the continuous four second polling cycle of drive status.
Root Causes	Drive has determined that there is a problem per its internal algorithms.
Possible CRU Replacement	Drive Sled
Resolution	1. Perform "DR037: Resolve Media Eject" on page 5-75. 2. From the Operator Panel, select **Tools** > **Service** > **Drives** to run the drive diagnostic. A blank, scratch cartridge is required for this test.

T053 - Unload Timeout

Description	A tape drive did not successfully unload a tape cartridge within the allotted time frame, preventing the robot from picking and moving the cartridge. The library is expecting the drive to achieve an unloaded state within 3 to 5 minutes of initiating the unload request, but the drive is still rewinding and unthreading the tape. This operator intervention is ONLY displayed if the tape drive was actually instructed to perform an unload operation and the drive did not respond with a successful or failed unload response within the allotted time frame. In the case where the library controller code is determining that the drive is still busy for a defined wait time period and the unload request is not sent to the tape drive, this operator intervention will not be generated, but rather the request to unload will be denied as an illegal request. **Note:** The library will not wait for the maximum unload time defined by the drive, as drives may take up to 18 minutes before succeeding or failing the unload or eject operation. The library will only wait for 3 minutes before failing the unload request.
Detection Scenarios	• A SCSI Move Medium was issued but the drive does not achieve an unload or eject state within the allotted time frame after being instructed to unload and eject. • A UI command was issued to unload or move from a drive, but the drive does not achieve an unload or eject state within the allotted time frame after being instructed to unload and eject.
Root Causes	The tape drive was instructed to unload the tape cartridge but did not complete the request within the allotted time frame.
Resolution	1. Perform DR006 - Resolve Unload Timeout "DR006: Resolve Unload Timeout" on page 5-62. 2. If possible, check the front of the tape drive for error indications.
Possible CRU Replacements	Drive Sled

T055: Drive TapeAlert 37 - Drive Detects Voltage Problem

Description	GUI Description: The drive has exceeded one of its voltage limits. Explanation: System determines that the drive has issued a Tape Alert 37 indicating that the drive brick detected a voltage problem.
Detection Scenario	The library determines there is a Tape Alert 37 through its Event Message exchange with the drive sled. The drive sled detects the Tape Alert 37 by its periodic polling of the drive brick.
Root Causes	1. Drive has determined that there is a voltage problem per its internal algorithms. 2. Drive detected a momentary voltage drop when a separate drive was being activated. 3. System power supply failure or fault.
Possible CRU Replacements	• Drive Sled • Power module
Resolution	1. Perform "DR083: Resolve Drive Voltage Problem" on page 5-87.

T060: Main Access Door Open

Description	GUI Description: A library access door has been opened. Explanation: At boot time or run time the library detects that at least one main door is open. The main access door switches are physically wired in series and the system firmware can not distinguish which switch/door is open. In addition, the health of the module-to-module connection and termination affects the series wiring of the switches. Firmware logic will not report this ticket if the module-to-module termination is totally missing or not proper.
Detection Scenario	Constant monitoring of the switch electrical circuit (hardware interrupt) detects a door open. This is true at run time or boot up.
Root Causes	1. Any main access door is actually open. 2. A number of electrical hardware failures in the door switch circuit (this includes intermittent issues). 3. Mechanical issues where door switch is not being made even though door is closed (this includes intermittent issues). 4. Disconnected module terminator or module-to-module cable. 5. Damaged module terminator or module-to-module cable with bent or broken pins.
Possible CRU Replacements	• Module-to-Module communication cable • Module communication terminator • Display/Door and I/E PCB
Possible FRU Replacements	• Door Interlock Switch • Internal cables and boards kit
Resolution	Perform "DR019: Resolve Open Access Door" on page 5-67.

T061: Tape Alert 55 - Loading Fail

Description	GUI Description: The tape drive encountered a problem while loading a tape cartridge. Explanation: When loading a tape into drive, a hardware malfunction can prevent the tape from being loaded in the drive, or the tape may actually get stuck in the drive.
Detection Scenarios	After loading a drive, the drive generates a Tape Alert 55, which is noticed by the library.
Root Causes	1. A drive hardware error that prevents the tape from being loaded. 2. A damaged tape that cannot be loaded into the drive.
Possible FRU Replacements	• Drive sled
Resolution	1. Perform “DR078: Resolve Tape Load/Unload Failure” on page 5-83. 2. Use the "Details" option in the RAS ticket to identify which tape drive reported the RAS ticket. Check for lock block condition. If possible, check the front of the tape drive for error indications. Clear the RAS ticket. 3. Open the main door and inspect the tape drive or path for obstruction. 4. Isolate the media used during the load operation and verify it is not damaged. 5. Finally, pull the drive sled from the sled bay and reseat it in another sled bay and retry the load operation. Additionally if using 400G library firmware or later, run the IVT - Drive test from the Library Tests option accessed through the Operator Panel. **Note:** IVT is optimized for library firmware versions 520G and above and libraries built after July 1, 2008 (serial numbers with last four digits 8609 and above). • If your library was built on or before July 1, 2008, and you are running firmware version 520G or above, you will not be able to run the IVT test, even though the selection is available. • If your library was built on or before July 1, 2008, and you are running firmware version 500G or below, you can run the test, but it is not recommended because it may produce erroneous results.

T062: Module Configuration Problem

Description	GUI Description: The library cannot determine its module configuration due to module-to-module cable connection or a module termination failure. Explanation: At boot time or run time the library physical frame configuration is not valid. The configuration is determined via address bits and module count bits that are routed through the module to module cabling and termination.

Detection Scenarios	1. Code determines that there is greater then one control module based on geographic address bits. 2. Code detects five frames or greater above the control module per the geographic address bits. 3. Code detects five frames or greater below the control module per the geographic address bits. 4. Code detects that one or more geographic address bit patterns do not match a valid configuration. 5. The code detects/communicates with a device (I/O Stations, power supplies, drives, blades, fan blades) that should not exist per the detected frame count and frame configuration. 6. Code determined frame configuration based on frame count and geographic address bit pattern does not match hard stops found by Y motion tests.
Root Causes	1. Greater than one control module exists in a stack of frames wired together. 2. Five frames or greater are actually above the control module. 3. Five frames or greater are actually below the control module. 4. Hardware failure results in one or more invalid geo bit patterns. 5. Hardware failure results in one or more valid but incorrect geo bit patterns when compared to frame count (more frames detected than actual or less frames detected than actual).
Possible CRU Replacements	• Module-to-Module communication cable • Module communication terminator • Library Control Blade
Possible FRU Replacements	• Internal Cables and Boards Kit • Expansion module enclosure
Resolution	Perform “DR010: Termination and Connectivity Diagnostic” on page 5-64.

T063: WWNN Label Change

Description	GUI Description: The robot cannot read or detected a new library WWNN. Explanation: The library logic learns the library WWNN of the system by reading an abbreviated base WWNN base volume serial number label. This is done at first boot up from a "cleared to ship" condition in order to establish the WWNN. It is also done on subsequent boot ups to verify that the persisted information on the library compact flash file system matches the physical library module. The library will report a problem when it cannot read the WWNN or it reads a WWNN value that does not match the persisted library configuration. A different motion related problem will be reported if motion is preventing the proper reading of the WWNN..
Detection Scenarios	1. At first boot up from clear to ship, the library must establish the WWNN for the first time. There may be no WWNN in system memory at this point. 2. Any power up. System memory already has a WWNN established for the Library Control Blade. 3. The Library Control Blade is improperly swapped into a different physical chassis and the system reads the physical chassis WWNN label. 4. The compact flash from a system already in use is placed into a new replacement module.

Root Causes	1. The Library Control Blade has been swapped between libraries. 2. WWNN label is damaged. 3. Bar code scanner is not working properly. 4. Entire communication path to bar code scanner is not working properly. 5. Library module is replaced.
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	• Picker • Internal Cables and Boards Kit
Resolution	Perform "DR007: Resolve Barcode Scanner Issue" on page 5-63.

T064: LCB Hardware Failure

Description	GUI Description: The library controller board experienced a hardware failure. Explanation: The library encounters an error which appears to be isolated to hardware on the Library Control Blade itself.
Detection Scenarios:	Code detects a board level voltage problem.
Root Causes:	Board level voltage problems.
Possible CRU Replacements:	1. Library Control Blade 2. Display/Door and I/E PCB (DIEB)
Resolution	• Observe library component LEDs (refer to "Interpreting LEDs" on page 6-17. • Refer to instructions to remove and replace the Library Control Blade (see "Library Control Blade or Compact Flash Card" on page 7-44).

T065: Robot Over - Current Condition

Description	GUI Description: Robot power is interrupted due to an over-current condition. Explanation: The library detects that the 42 V picker supply circuit on the LCB is not at an acceptable voltage. Field data indicates that this is most likely an issue with the LCB rather than a picker assembly issue.
Detection Scenarios	Monitoring of voltage divider indicates partial or complete voltage drop
Root Causes	1. The 48 V to 42 V conversion power supply on the LCB has shut down due to excessive current draw. 2. Board level hardware failures 3. Permanent or temporary short in cables, connectors, Picker 4. Various hardware failures in Picker that cause too much current to be drawn. 5. Shorted module terminators or module-to-module cable pins.
Possible CRU Replacements	• Y- Carriage Assembly • Library Control Board
Possible FRU Replacements	Picker
Resolution	Perform "DR035: Resolve Robot Power Interruption" on page 5-74

T066: Drive Power Fuse (F1) Blown

Description	GUI Description: Drive power is interrupted due to a blown fuse. Explanation: The library detects that an F1 drive fuse located on a Drive Sled Interface Board (DSIB) has failed. Each module has a DSIB card to provide an electrical connection point for the drive sleds. Each DSIB has a replaceable fuse for the overall drive power bus. This protects the core library hardware components from some type of short or over current problem in one or more drives.
Detection Scenarios	• Monitoring of voltage divider indicates partial or complete voltage drop
Root Causes:	1. Board level hardware failure 2. Permanent or temporary short circuit conditions in drives, drive sleds, docking connectors, etc.
Possible CRU Replacements	Drive Sled
Possible FRU Replacements	• DSIB fuse, 5U or 9U
Resolution	1. Remove all drive sleds, close the ticket, reboot the library, and see if the ticket reoccurs. 2. If the ticket reoccurs with all drive sleds out, check the fuse. If the fuse is blown, replace per "Remove and Replace Drive Power Fuse" on page 7-129. 3. If the ticket does not reoccur with all sleds out, install one drive sled at a time, checking to see if a ticket occurs for each one to see which drive sled is causing the ticket. Replace the defective drive sled.

T067: Display Assembly Hardware Failure

Description	GUI Description: A local display assembly hardware failure has been detected. Explanation: The library encounters an error which appears to be isolated to Operator Panel hardware. This includes the Operator Panel board.
Detection Scenarios	No communication with Operator Panel board.
Root Causes	1. Blown DIEB fuse. 2. Rare power supply problem where too much voltage is transferred to the display. 3. DIEB temperature limit exceeding threshold. 4. LCB failure.
Possible FRU Replacements	• Operator Panel • Internal Cables and Boards Kit
Resolution	Remove and replace the Operator Panel (see "Operator Panel" on page 7-27).

T068: Destination Element Full

Description	GUI Description: The robot determined that a destination location for a tape cartridge move operation is already full. Explanation: The robot has attempted to put to a drive, I/O, or storage element and has determined that the element is full. This is distinctly NOT a SCSI illegal request situation. At the beginning of the move media, the library inventory has indicated that the destination element was in an empty state to allow it to be a valid destination. During recovery operations, the library has concluded that the cell is obstructed by a piece of media. Any failure that is not thought to be a piece of media in the destination should not be mapped to this ticket.
Detection Scenarios	• The destination element for a move media is full with a LABELED cartridge. Library inventory does not know that the cell is full. • The destination element for a move media is full with an unlabeled cartridge. As part of recovery, the library attempts to perform a get from the cell. If the get succeeds and a tape cartridge is detected in the picker by the tape present sensor, then the slot is designated as full with an unlabeled tape present.
Root Causes	• Inventory has not occurred since cartridge was placed in element by some manual operator intervention. • An unlabeled tape is placed in a slot by a user (not by the robot).
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR020: Resolve Library Inventory Mismatch” on page 5-68.

T069: Source Element Empty

Description	GUI Description: The robot determined that a source location for a tape cartridge move operation is empty. Explanation: The robot has attempted to get from a drive, I/O, or storage element and has determined that the element is empty. This is distinctly NOT a SCSI illegal request situation. At the beginning of the move media, the library inventory has indicated that the source element was not in an empty state and it was a valid source for a move media command. During recovery operations, the library has concluded that the cell is genuinely empty. Empty is defined as NOT containing a cartridge with a readable volume serial number.
Detection Scenarios	The library fails to successfully get a cartridge during a move media. The cartridge present sensor in the Picker indicates no cartridge at the conclusion of a GET and a subsequent inventory scan of the cell indicates that no cartridge is present.
Root Causes	Inventory has been manually changed since last robotic inventory. Cartridge was removed from or moved within the system.
Possible CRU Replacements	Tape Cartridge
Resolution	Perform “DR020: Resolve Library Inventory Mismatch” on page 5-68.

T070: Library Control Path Failure

Description	GUI Description: The library control command path through a tape drive has failed. Explanation: The library media changer control path through a drive has failed. The host that owns and runs the logical library can no longer be expected to be able to control the library. The control path must be fixed or a user could choose to switch the control path to a different drive within the same logical library.
Detection Scenarios	1. The loss of communications between the library and the drive sled 2. The loss of communications between the drive sled controller board and the drive brick.
Root Causes	1. Various hardware problems inside the drive sled. 2. Tape Drive (brick) firmware problem 3. Drive sled firmware problem 4. Library communication firmware problem 5. Drive Sled Interface Board (DSIB) hardware problem 6. Loss of power to sled (DSIB 48 V fuse)
Possible CRU Replacement	Drive Sled
Resolution	• Update drive firmware (see “Updating Drive Firmware” on page 6-27. • Update library firmware (see “Updating Library Firmware” on page 6-26. • If the problem still exists, replace the drive sled (see “Drive Sled” on page 7-42).

T071: Missing Power Supply

Description	GUI Description: A previously installed power supply is missing. The library can no longer detect the presence of a power supply that was previously physically installed and logically added to the system.
Detection Scenarios	Regular polling between LCB and power supply checks for presence of the power supply.
Root Causes	1. Power Supply has been physically removed after being added to a powered ON system. 2. Hardware failure inside supply 3. Hardware failure in library side connector of other electronics. 4. Disconnected module terminator or module-to-module cable. 5. Damaged module terminator or module-to-module cable with bent or broken pins.
Possible CRU Replacements	1. Module Terminators and Module-to-Module Cables 2. Power Supply
Resolution	Perform “DR022: Resolve Missing Power Supply” on page 5-68.

T072: Unmanaged System Fault

Description	GUI Description: The library encountered an unmanaged fault. Explanation: Library firmware has reported a problem that is not associated with a specific ticket and corresponding diagnostic resolution. This problem cannot be resolved without escalation to tech support and engineering.
Resolution	Perform "DR021: Contact IBM Service" on page 5-68.

T073: I/O Storage Door Open

Description	GUI Description: An I/O station door configured for storage is open. Explanation: Certain I/O station doors can be designated as storage slots. When one of these doors is open, the system should not become operational because these storage slots would not be available to the robot. The ticket is posted as a means of informing the user that the library cannot become operational and that they should close the door so the system can lock it and start using it.
Detection Scenario	1. When the main doors are closed and the robot attempts to initialize, the state of "I/O Storage Doors" will be checked. 2. When the library powers up and the robot attempts to initialize, the state of the "I/O Storage Doors" will be checked.
Root Causes	1. I/O Storage door is left open by user. 2. Hardware failure in the I/O door open/closed sensing. 3. Stuck lock assembly sensor switches.
Possible FRU Replacements	• I/O Lock Assembly • I/O Magazine Slide Assembly
Resolution	Perform "DR034: Resolve Open Storage I/O Door" on page 5-73.

T074: Drive Sled Auto-Leveling Failure

Description	GUI Description: The drive sled assembly failed to automatically update its firmware to the correct version. Explanation: The normal auto level process for a sled did not work. When a drive sled is inserted into a powered ON library or when a library powers ON, the firmware level of the drive sled is checked to be consistent with the level required by the main library firmware. If the level is not correct, the sled will be up-leveled or down-leveled accordingly. Failure in this process to set the correct firmware level in the sled results in this ticket.
Root Causes	1. Physical interruption of the firmware down load process. 2. Firmware problems. 3. Hardware failures that result in intermittent or failed communication between library and drive sled.
Possible CRU Replacements	• Firmware • Drive sled
Possible FRU Replacements	Internal Cables and Boards Kit
Resolution	Perform "DR033: Resolve Drive Sled Auto-Level Failure" on page 5-73.

T075: Unsupported Module Configuration

Description	GUI Description: The installed library firmware does not support the detected module configuration. Explanation: The current level of library firmware does not support the module configuration as detected by scanned module serial number labels. The firmware will allow 5U, 14U, 23U, 32U, and 41U configurations. It will specifically not run with anything greater than 41U or with a 10U configuration.
Detection Scenario	During initialization, the robot reads serial numbers on the modules that are present.
Root Causes	1. The system really is an invalid configuration and all modules are labeled correctly. 2. A chassis module is not labeled correctly. 3. The firmware level loaded on the library does not support a valid configuration. 4. Bar code reader is not scanning the labels correctly.
Possible CRU Replacements	Firmware
Possible FRU Replacements	**Note:** Read and perform all resolution steps before dispatching any parts. Dispatch the first part listed below for replacement. If this does not solve the problem, dispatch the second part, and so on, in order. Dispatch only one part (or set of parts) at a time. • Picker Assembly • Module (EM or CM) - only dispatch this FRU if the label is missing or damaged
Resolution	Perform “DR026: Resolve Unsupported Module Configuration” on page 5-70.

T076: Robot Initialization Failure

Description	GUI Description: The robot did not initialize properly. Explanation: This ticket is designed to notify the user if the robot cannot initialize at all. The problem most likely lies with the cable spool, so it should be replaced first, unless examination of the module terminator and module to module cables reveal a defect. The robot assembly should be replaced second, as that has the next greatest probability of resolving the problem. Unless, per the resolution strategy, the customer has found another damaged part, no other parts should be dispatched until after these two have been replaced.
Detection Scenario	1. Any time the main door(s) closes and the robot goes through an initialization sequence. 2. At power up of the library if the main door(s) is closed.
Root Causes	1. Complete loss of connection to robot (i.e. unplugged cable spool or equivalent). 2. Broken connection to Y-motor 3. Numerous hardware failures on the picker assembly
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	• Module Terminators and Module-to-Module Cables • Cable Spool • Robot Assembly

Resolution	Perform “DR031: Resolve Robot Initialization Failure” on page 5-72.

T077: I/O Station Partially Partially Open

Description	GUI Description: The I/O station is in a partially open state or a cable connection has failed. Explanation: This ticket is specifically designed to report the problem that would occur if the cable connecting any of the I/O stations is unplugged. Hardware limitations make it such that and unplugged I/O and a partially open I/O cannot be distinguished from one another. The default state of the open and closed door sensors is such that only the partially open state looks like the unplugged state (door not open + door not closed). The detection logic will check for this condition only at boot up to avoid triggering the ticket during any operational door open / close sequence.
Detection Scenario	Any time the library boots up it checks for the state of the I/O open and close sensors to see if there is a not open and not closed condition.
Root Causes	1. I/O station safety flap broken or loose. 2. I/O station is unplugged at boot up 3. I/O station is left in a not open and not closed state at boot up
Possible FRU Replacements	• I/O Station Lock assembly • I/O station safety flap • Internal Cables and Boards Kit
Resolution	Perform “DR036: Resolve Partially Open I/O Station” on page 5-74.

T079: Get Operation Failed, Motion OK

Description	GUI Description: The robot failed to pick a tape cartridge. Explanation; The library cannot successfully get a tape from a drive, storage or I/O location. The tape is still resting in the source location. The robot is not obstructed in any way and can continue operations (unlike the case for T003). If the operation was initiated by a host move media, the move media command has failed with an ASC/ASCQ of 4h/15h/01h (hardware mechanical positioning error).
Detection Scenario	The picker cannot get a tape from the source location. It can scan or touch the tape to verify that it is present.
Root Causes	1. Picker has broken fingers. 2. Picker has bad calibration so it is not positioned correctly. 3. Picker has bad **'y'** gears so it is not at the height it thinks it is at. 4. An obstruction that prevents the picker fingers from getting into the tape grooves. 5. A bad tape that is jammed and stuck in the slot. 6. A damaged slot or drive that will not release the tape.
Possible CRU Replacements	• Cartridge
Possible FRU Replacements	• Picker • Y-axis assembly • Column assembly
Resolution	Perform “DR076: Resolve Get Failure” on page 5-82.

T080: Module SN Change

Description	GUI Description: The library detected the removal of an expansion module or a replacement of the control module. Explanation: When the library powers ON and the robot initializes, the bar code serial number (SN) labels in each module are scanned by the robot beginning at the bottom of the library (closest to the y-axis home) and then working up. The library uses the control module (CM) SN and any expansion module SN to establish key operational properties and characteristics of library storage slots and partitions. A change in the CM SN or the removal of an EM (even if it is replaced with another EM) will "break" any already established partition in such a way that it must be deleted. This ticket was designed to notify the user that a condition exists that requires the deletion of a partition(s) and allow the user to assess whether perhaps human error is involved such as mixing the Library Control Blade's compact flash memory between libraries.
Detection Scenario	At library boot up time, the robot attempts to scan all module SN's. When SN's are discovered, they are compared to persisted data on the system compact flash.
Root Causes	1. An LCB is improperly swapped into a different physical module and the system reads the physical module label. 2. A CM chassis FRU is replaced in an already configured system 3. A previously detected and configured EM is removed completely from a vertical stack of modules. 4. A previously detected and configured EM is removed completely from a vertical stack of modules and replaced with another EM of similar OR different size and location. 5. Bar code reader is not scanning the labels correctly. 6. Scratched or damaged label.
Possible FRU Replacement	• Picker Assembly
Resolution	Perform "DR039: Resolve Logical Library Deletion" on page 5-75.

T081: Incorrect Module Brand

Description	GUI Description: The library detected an incompatible module brand that does not match the library configuration. Explanation: The branding of a system is accomplished in two different ways. The firmware uses information saved on the compact flash to determine what brand the firmware and GUI's will present to the user. There is also physical branding of the system in the form of different cosmetic skins, badging, paint, external labels, etc. on each module. In addition, each module has a machine readable bar code label that carries a module serial number (SN) and branding information that should match the physical branding of the module. The library manufacturing process should install a machine readable bar code label that matches the external, user visible branding of the module. Because the library robot can read this bar code label, it can check the branding of the physical modules against the branding of the firmware and GUI's. This ticket is a defensive tool used to notify the user that there is a mismatch in the branding mechanisms. The root cause of a mismatch can be manufacturing defects, logistical errors (shipping the wrong spare part), or user errors such as moving parts between systems.

Detection Scenario	At library power ON, the robot attempts to scan all module bar code labels. When the OID number on each label is read, the embedded branding information is compared to persistent data on the system compact flash.
Root Causes	1. Various manufacturing defect errors, mislabeling or part mix ups. 2. Spare part logistics error where wrong module FRU or compact flash FRU is sent to a customer site. 3. End users or Service personnel mixing and matching hardware from multiple systems of different branding in the field. 4. Malicious intent where customers attempt to buy and combine hardware from different sources. 5. Bar code reader is not scanning the labels correctly.
Possible FRU Replacement	• Picker Assembly
Resolution	Perform "DR040: Resolve Incompatible Module Branding" on page 5-75.

T082: Volume Serial Scanner Failure

Description	GUI Description: The library volume serial scanner is not operating properly. Explanation: The volume serial scanner is detected to be in a state where the library control logic cannot use it. Library robot power is known to be applied (door is closed and robot is detected to be functioning enough to confirm power is applied) and yet scanner communication cannot be established at all or appears to be not healthy.
Detection Scenario	1. During any library power ON or door close operation, Picker power is applied and bar code scanner communication is established. 2. During run time operations such as inventory where the bar code scanner is used.
Root Causes	1. Scanner is physically disconnected 2. Various electrical hardware failures that prevent proper communication between the Library Control Blade and bar code scanner. 3. Bar code reader is not scanning the labels correctly.
Possible CRU Replacements	Library Control Blade
Possible FRU Replacements	**Note:** Read and perform all resolution steps before dispatching any parts. Dispatch the first part listed below for replacement. If this does not solve the problem, dispatch the second part, and so on, in order. Dispatch only one part (or set of parts) at a time. • Picker assembly • Cable Spool • Y- carriage Assembly
Resolution	Remove and replace the Picker. Refer to "M2 Picker Assembly" on page 7-82.

T083: Unlevel Robot Assembly Not Level

Description	GUI Description: The robot assembly does not seem to be horizontally level and may be installed improperly. Explanation: The firmware has detected a condition that indicates the robot assembly (Y-carriage and picker) is not installed level within the system. The robot assembly has drive gears that mate with rack gears inside the library modules. There are field assembly problems and hardware failure problems that can cause the robot assembly to be not level and therefore not function properly.
Detection Scenario	1. The robot cannot move to its Y-axis parking position after homing in Y because the front of the Y Carriage hits the floor. Parking position is below homing position. 2. Front and back magazine fiducial positions on the left side are not at the same Y level. This test algorithm can detect non-level conditions in both directions (front high or back high). **Note:** There are a few known false detection scenarios: Certain specific size obstructions sitting on the floor of the library. Magazines not seated correctly. Damaged fiducials that can be detected as mis-positioned because they are damaged.
Root Causes	1. Robot drive gears not installed in Y racks at the same time. This can result in the two ends of the Y Carriage being 1 to 2 teeth out of synchronization. 2. Y racks not seated properly/evenly. Both the front and rear Y rack are intended to be released from their shipping latches and lowered such that the racks in the very bottom module rest on the floor of the unit. 3. There are hardware failure and assembly failure modes that can result in the front and rear drive gears on the Y Carriage being excessively out of phase with each other. 4. Robot Lock mechanism is out of position and interfering with the robot Y-axis travel.
Possible FRU Replacements	• Y-axis Assembly • Internal Cables and Boards Kit
Resolution	1. Perform “DR041: Resolve Robot Installation” on page 5-76. See also “Removing the M2 Robot Assembly from the Library” on page 7-77 and “Replacing the M2 Robot Assembly” on page 7-79. 2. This RAS ticket appears almost exclusively for a picker and Y-carriage Assembly climber not being level. Clear the RAS ticket. Remove these components from the unit and then re-seat them to ensure they are level. 3. Inspect the picker rails inside the unit and make sure they are level, flush with the unit, and properly locked into place. 4. Ensure the entire library is level in the rack. 5. Only dispatch the above FRU after all efforts have been exhausted to get the unit and picker/Y-carriage assembly level.

T084: Missing Cleaning Tape

Description	GUI Description: A cleaning tape cartridge, configured for automatic library-initiated cleaning, is missing. Explanation: When using the library to manage drive cleaning, the cleaning cartridges that are imported into the library are not visible to any host and are not part of any logical library. Rather, they are in the "system" logical library. Under all circumstances, the user should use the insert and remove cleaning cartridge functions to move cleaning cartridges into and out of the cleaning slots in this "system" logical library. If the library becomes aware during inventory that a system cleaning cartridge has been removed manually (through an open door and/or with the power OFF) this ticket will be used to notify the user that this cleaning resource is now missing. Because the cartridge has gone missing, the library cleaning functionality is no longer intact. It is either degraded (fewer cartridges available) or totally absent (no cleaning cartridge in the library).
Detection Scenario	1. When library inventory occurs during robot initialization from a power ON. 2. When library inventory occurs during robot initialization from a door close.
Root Causes	1. User removes cartridge manually instead of via remove cleaning media GUI functionality. 2. Bar code label on a system cleaning cartridge is not read during inventory. 3. Any scenario where a properly inserted system cleaning cartridge which has not yet been properly removed is detected to be missing based on library inventory operations.
Possible CRU Replacements	Cleaning cartridge
Resolution	1. Perform "DR042: Resolve Missing Cleaning Cartridge" on page 5-76. 2. If auto-cleaning is enabled, ensure a cleaning tape is loaded in the correctly specified cleaning slot in the library.

T085: Unknown Cartridge in Cleaning Slot

Description	GUI Description: A configured cleaning slot contains an unknown tape cartridge which will not be used for automatic library-initiated drive cleaning operations. Explanation: When using the library to manage drive cleaning, the cleaning cartridges that are inserted into the library are not visible to any host and are not part of any logical library. Rather, they are in the "system" logical library. Under all circumstances, the user should use the insert and remove cleaning cartridge functions to move cleaning cartridges into and out of the cleaning slots in this "system" logical library. If the library becomes aware during inventory that an unexpected (non-inserted) cartridge has been inserted into a cleaning slot manually (through an open door and/or with the power OFF) this ticket will be used to notify the user that this slot contains a cartridge that cannot be used for cleaning. Because the cartridge was not inserted as a cleaning cartridge, the library cleaning functionality is no longer intact. It is either degraded (fewer valid cartridges available) or totally absent (no valid cleaning cartridge in the library).

Detection Scenario	1. When library inventory occurs during robot initialization from a power ON. 2. When library inventory occurs during robot initialization from a door close.
Root Causes	1. User adds a cartridge manually instead of via the insert cleaning media GUI functionality. 2. Any time a cleaning slot is defined via the GUI functionality and there is a rogue, labeled cartridge in the slot. This can occur under door open conditions or covers off. 3. Any scenario where a bar code labeled cartridge ends up in a cleaning slot by means other than via the proper insert GUI functionality.
Possible CRU Replacements	Cleaning cartridge
Resolution	Perform“DR043: Resolve Invalid Cleaning Cartridge” on page 5-77.

T086: Inaccessible Tape Cartridge

Description	GUI Description: A tape cartridge is located in a storage location that is not accessible by the library robot. Explanation: In library configurations of 23U or more, the top storage slot in each of the two columns on the top row of the right side of the library (columns 4 and 5) become inaccessible to the library robot. When the vertical stack of library modules becomes 23U or higher, the robot is no longer adequately supported by the y-racks to get and put tape cartridges from these two specific storage slots. All other storage slots in the library remain accessible. This ticket is produced when a user manually inserts a cartridge into one of these slots and the library detects the cartridge during inventory. The library itself will not load a cartridge into one of these slots via host or Operator Panel commands. The slots themselves will not be presented as usable in logical libraries. Although the library cannot reliably get and put tapes from these storage locations, the library can still discover volume serial labeled tapes in these slots during normal inventory operations. Because these slots are inaccessible, they are not part of the library's inventory and the ticket WILL NOT list their locations in the details. It will simply list "None."
Detection Scenario	In libraries of 23U or greater, the library discovers a bar code labeled cartridge in the top slot of either column 4 or 5 during inventory.
Root Causes	A user manually places a cartridge in the top slot of either column 4 or 5 during inventory in a library that is at least 23U or greater.
Possible CRU Replacements	Cartridge
Resolution	Perform “DR050: Resolve Invalid Tape Location” on page 5-79.

T087: Invalid Library SN Label Warning

Description	GUI Description: The library's serial number barcode label cannot be read by the robot but the library is able to initialize and continue operation. Explanation: The library logic learns the serial number of the system by reading an internal serial number label. The service tag is located on the same label as the serial number. This is done at first bootup from a "clear to ship" condition in order to establish the serial number. It is also done on subsequent bootups to confirm that the compact flash memory card is in the proper library. The library will report this operator intervention message when it cannot read the library serial number but it has confirmed functionality of the barcode reading system by successfully reading some other barcode label in the library and it has the library serial number stored in memory from a previous successful read. When this operator intervention message is posted, the user can be confident that at least one other barcode label has been read. For example, barcodes that can be used the check functionality are: • WWN or SN (in control modules) • OID (in expansion modules) Different tickets will be posted if there are motion-related problems, scanner communication problems, and so on.
Detection Scenario	Any power-up. System memory already has a valid SN established for the LCB.
Root Causes	• Label is damaged. • Label is missing. • Label is physically obstructed. • Label is readable but does not meet minimum criteria to be considered a library SN label. • Scanner cannot read the serial number label.
Possible CRU Replacements	• LCB Flash Memory • LCB
Possible FRU Replacement	• Module (EM or CM) - only dispatch this FRU if the label is missing or damaged. • Picker Assembly • Y- carriage Assembly
Resolution	1. Perform “DR051: Resolve Library SN Label Detection” on page 5-79. 2. Inspect the label inside the unit for damage. 3. Clear the RAS ticket. 4. Upgrade the library firmware to 400G or later and run the IVT - Picker test using the Library Tests option accessed through the Operator Panel. If the test passes, the issue is most likely not the picker. **Note:** IVT is optimized for firmware to firmware versions 520G and above and libraries built after July 1, 2008 (serial numbers with last four digits 8609 and above). • If your library was built on or before July 1, 2008, and you are running firmware version 520G or above, you will not be able to run IVT test, even though the selection is available. • If your library was built on or before July 1, 2008, and you are running firmware version 500G or below, you can run the test, but it is not recommended because it may produce erroneous results.

T089: E-mail Notification Error

Description	GUI Description: A library-initiated e-mail notification did not reach its destination. Explanation: The user can configure the library to send an e-mail to a specified address whenever a operator intervention message is generated or a configured Advanced Reporting log notification is sent. This e-mail will include a description of the operator intervention message and will optionally include the library current log. The library will report this operator intervention message if it receives any error codes when trying to send out this e-mail. This operator intervention message indicates that there is something wrong with the customer's internal network or its settings, but there is no error on the library side. Note that the library cannot detect all errors that could occur on a network, but can determine if the e-mail was successfully sent to the mail server on the network.
Detection Scenario	• Any time a RAS ticket is generated and the library has been configured to generate a RAS email. • Any time a Advanced Reporting Notification has been configured and the scheduled sending of such log(s) experiences an error.
Root Causes	• Email settings on the library are not correct. • The library is not connected to the network. • Library is plugged into the wrong network port. • Network cable is damaged. • E-mail server is down. • Some other configuration error on the customer's network.
Resolution	Perform “DR053: Resolve Network Configuration Issue” on page 5-80.

T090: Invalid Cleaning Tape

Description	GUI Description: A non-cleaning tape cartridge was used to attempt to clean the drive. System determines that the tape used to attempt to clean a drive is not a cleaning tape. This ticket differs from the Tape Alert 23 ticket (T048) in that this ticket will be generated anytime a non-cleaning tape is used to clean a drive, not just in the case where the drive requires cleaning and posts a Tape Alert 23.
Detection Scenario	After loading a tape to clean a drive, the system notices that cleaning has not begun within 30 seconds.
Root Causes	• User or library attempts to mount a cleaning tape but the tape is not actually a cleaning tape. • User mistakenly loads a data tape as a cleaning tape. • Inventory or application issue results in data tape being loaded when drive expects cleaning tape.
Resolution	Perform “DR077: Resolve Invalid Cleaning Tape” on page 5-83.

T091: Tape Alert 56 - Unload Failure

Description	GUI Description: The tape drive encountered a problem while unloading a tape cartridge. Explanation: When attempting to unload a tape, a drive brick hardware malfunction can prevent the tape from being ejected. The tape may actually be stuck in the drive.
Detection Scenario	After unsuccessfully attempting to unload a tape, the drive generates a Tape Alert 56, which is noticed by the library.
Root Causes	• A drive hardware error that prevents the tape from being unloaded. • A damaged tape that cannot be unloaded from the drive.
Possible FRU Replacements	• Drive sled
Resolution	Perform "DR078: Resolve Tape Load/Unload Failure" on page 5-83.

T092: Unreadable Branding Identifier

Description	GUI Description: The library could not read the branding identifier. Explanation: The library logic learns the branding of the system by reading an internal label. The branding identifier is located on the same label as the serial number. This is done at first boot up from a "cleared to ship" condition in order to establish the library personality. It is also done on subsequent boot ups to confirm that the Compact Flash memory card is in the proper library. The library will report this ticket when it cannot read the library branding code but it has confirmed functionality of the bar code reading system by successfully reading some other bar code label in the library. When T092 is posted, the user can be confident that at least one other bar code label has been read. For example, bar codes that can be used to check functionality are: WWN or SN (in CM cases). Different tickets will be posted if there are motion-related problems, scanner communication problems, etc.

Detection Scenario	Picker cannot accurately read the OEM identifier barcode on the control module label.
Root Cause	Label may be damaged or missing.
Possible FRU Replacements	• Module (EM or CM) - only dispatch this FRU if the label is missing or damaged. • Picker Assembly
Resolution	Perform "DR080: Resolve Unreadable Branding" on page 5-84.

T093: Automatic Cleaning Failure

Description	GUI Description: The library detected a problem during an automatic cleaning operation. Explanation: When the library is set up for Auto Clean, all the normal tickets for cleaning issues are disabled, since the auto clean mechanism will resolve any of these RAS tickets automatically. There is, however, one case where a ticket needs to be posted: If the auto clean mechanism itself fails. This is the only ticket that will be produced.
Detection Scenario	Auto Clean mechanism fails.

Root Cause	1. Auto Clean setup error (such as a user manually removing a cleaning cartridge) 2. Any tape, motion, or driver error for which there already exists a RAS ticket
Resolution	Perform "DR081: Resolve Autoclean Failure" on page 5-84.

T094: Drive Bay Open

Description	GUI Description: A library drive bay in the rear of the library is open. Explanation: At boot time or run time the library detects that at least one of the unoccupied drive bays does not have a cover on it. For safety reasons, if a drive bay is not occupied by a drive and does not have a cover plate installed, the robot is slowed to half speed to minimize the risk of someone putting their hand inside the library and having the robot run into it at full speed. Library operations will take twice as long in this state. As users normally remove the drive bay covers to insert or move drives, this library will wait between 30 seconds and 10 minutes after detecting this condition to post the operator intervention message. The library does not have the capability of displaying the location of the open drive bay.
Detection Scenario	• Missing drive cover plate • Drive cover is loose or ajar and not electrically connected
Root Causes	• User removed the panel and forgot to put it back. • Cover plate was not put on securely and the electrical connection is not solid. • The cover plate is damaged in such a way that the electrical connection cannot be made. • Drive pulled back.
Possible CRU	Drive cover plate.
Resolution	Perform "DR054: Resolve Open Drive Bay" on page 5-80.

T095: Installation and Verification Test (IVT) Failure

Description	GUI Description: A sub-test failed during the Installation & Verification Test. Explanation: The library contains a verification test that can be run to validate that the system has been installed properly and is up and running. Errors can occur during this test. The library will post this ticket whenever an error occurs during this Installation & Verification Test that does not affect the overall functionality of the library. It is more of a warning that a problem may be developing.
Detection Scenario	During the Installation & Verification Test run, any library error occurs that is not already handled by an existing RAS ticket.
Root Causes	Any function that is executed by the Installation & Verification Test that does not complete successfully.
Resolution	Perform "DR021: Contact IBM Service" on page 5-68.

T096: Module Communication Error

Description	GUI Description: An error occurred while trying to communicate with a module. Explanation: The system is having a problem finding and/or communicating with all the modules in the library.
Detection Scenario	At boot up, the library cannot determine the status of all modules.
Root Causes	• Bent pin on a terminator or a module-to-module cable. • I/O station sensor error. • I2C bus error.
Possible CRU Replacements	• LCB • Module-to-module cable • CAN Bus terminator
Possible FRU Replacement	• CM or EM module • I/O Station assembly • I/O Lock assembly
Resolution	Perform “DR056: Resolve Module Communication” on page 5-80.

T108: Incompatible Drive Brand

Description	GUI Description: An incompatible drive sled installation has been detected. Explanation: Different library configurations support different drives. The drive sleds will contain certain configuration information that the library will use to validate that the drive is indeed configured properly. If a drive's configuration data does not match what the library expects, the drive will not be usable and this ticket will be generated.
Detection Scenario	When drive is installed, the configuration data does not match what is expected.
Root Causes	• User installed a drive from a different brand library. • User did not purchase the drive from an official TS3310 sales channel. • Drive sled does not have the correct configuration information programmed.
Possible FRU Replacement	Drive sled
Resolution	Perform “DR068: Resolve Incompatible Tape Drive” on page 5-81.

T109: Drive Firmware Update Failure

Description	GUI Description: A tape drive firmware update failed. Explanation: Tape drive firmware can be upgraded by using a FMR tape or by downloading the firmware to a drive through the web user interface, the I/O blade, or by means of a host utility. After the upgrade process is complete, the library checks to verify that the drive reports the new firmware version. If not, this ticket is generated. This ticket is generated only when the user upgrades the drive firmware manually, and does not apply when the drive firmware is upgraded by autoleveling.
Detection Scenario	After a drive firmware updated, the new version from the drive does not differ from the old version.

Root Causes	• The firmware image that was used to update the drive was the same as what was already installed on the drive. • A firmware upgrade cartridge with an incompatible firmware version (wrong generation, drive type, etc.) was used. • The firmware upgrade cartridge used did not have valid firmware. • The firmware image was successfully transferred to the drive, but was corrupt or incomplete. • Error in drive communication or other drive specific error.
Possible FRU Replacement	Drive sled
Resolution	Perform “DR069: Resolve Drive Firmware Update Failure” on page 5-81.

T110: Drive Firmware Mismatch Detected

Description	GUI Description: A mismatch in tape drive firmware versions has been detected. Explanation: Each drive installed in the library is programmed with firmware from the drive manufacturer. All drives in the library should have the same firmware version. The library checks the library firmware version upon initialization and again when a new drive is inserted. If the drive do not all have the same firmware, a ticket will be generated. Rather than trying to list all the differences, the ticket will simply instruct the user to look at the System Information screen to identify which drives need to be updated.
Detection Scenario	On initialization, the library detects that not all drives have the same firmware version.
Root Causes	A drive was installed that had a different firmware version than other drives in the library.
Possible FRU Replacement	Drive sled
Resolution	Perform “DR070: Resolve Tape Drive Firmware Mismatch” on page 5-81.

T112: Invalid Tape Drive Firmware Image

Description	GUI Description: A stored tape drive firmware image is not usable for auto-leveling of a tape drive. Explanation: During initialization or when a drive is inserted while the library is operating, the library checks the product firmware level of the installed tape drive (brick) and compares that version to the version that it stores internally in its file system. If they are not the same, the library automatically updates the tape drive (brick) with this internally stored code image.
Detection Scenario	The automatic updates of the tape drive firmware fails.
Root Causes	The tape drive firmware image stored on the library's file system is corrupt.
Resolution	Perform “DR072: Resolve Tape Drive Auto-level Failure” on page 5-82.

T114: Unassigned Tape Cartridge

Description	GUI Description: A tape cartridge has been detected in a storage location that is not assigned to any partition. Explanation: At bootup, or after a door open event, the picker performs an inventory of the entire library. If a cartridge is located in a slot that is not part of a logical library, the cartridge will be inaccessible to the user and must be manually removed. This ticket will be generated upon the first occurance of such a cartridge; a separate ticket will not be generated for each cartridge found.
Detection Scenario	During inventory, a cartridge is found in a slot that does not belong to a logical library.
Root Causes	• Tape was manually placed into the slot. • A partition was deleted that contained media and the library was power cycled or the main door was opened.
Resolution	Perform "DR074: Resolve Unassigned Inaccessible Tape Cartridge" on page 5-82.

T115: Installation & Verification Test Warning

Description	GUI Description: A marginal, but still operable, assembly condition was found during the Installation & Verification Test. Explanation: The library contains a verification test that can be run to validate that the system has been installed properly and is up and running. Errors can occur during this test. The library will post this ticket whenever an error occurs during this Installation & Verification Test that does not affect the overall functionality of the library. It is more of a warning that a problem may be developing.
Detection Scenario	During the Installation & Verification Test run, when any error occurs that is not serious enough to limit library functionality.
Root Causes	Any function that is executed by the Installation & Verification Test that does not complete successfully.
Resolution	Perform "DR075: Resolve Installation & Verification Test Warning" on page 5-82.

T116: Robotics Firmware Image Error

Description	This ticket occurs with **Model 2** robots only. GUI Description: The robotics firmware auto-level process cannot be performed because necessary files are missing or corrupted. Explanation: The library is unable to attempt the Robotics Firmware auto-level process. In this case, the Robotics Firmware auto-level is not attempted and the Robotics subsystem is left in the 'not ready' state.
Detection Scenario	1. A necessary auto-level file is missing in the library firmware. 2. A necessary auto-level file failed validation.
Root Causes	Firmware corruption.
Possible FRUs	Library firmware
Resolution	Perform "DR084: Resolve Robotics Firmware Image Error" on page 5-87.

T117: Robotics Auto-Level Failure

Description	This ticket occurs with **Model 2** robots only. GUI Description: The robotics firmware auto-level process failed to update either the robot flash image or the scanner flash image. Explanation: The normal firmware auto-level process for robotics was not successful. Each time the robot is initialized, the firmware level of the robot is checked to be consistent with the level required by the main library firmware. If the level is not correct, the robotics firmware will be up-leveled or down-leveled accordingly. Failure in this process to update to the correct robotics firmware level results in the generation of this ticket.
Detection Scenario	The Robot Controller Board could not perform one of the following operations: 1. Validate the received flash image 2. Program its flash with the Robot flash image. A necessary auto-level file failed validation.
Root Causes	1. Flash Image CRC failure on the received file. 2. Hardware failures that result in unsuccessful flash programming.
Possible FRUs	• Picker Assembly • Robot Assembly
Resolution	Perform “DR085: Resolve Robotics Auto-Level Failure” on page 5-87.

T118: Degraded Robotics Flash

Description	This ticket occurs with **Model 2** robots only. GUI Description: The robotics firmware auto-leveling process completed but failed to update one of the redundant robot controller flash partitions. Explanation: The library was not able to update one of the robotics flash parts (but the other was successfully updated). The robotics subsystem can still become ready, but the flash is in a degraded mode and the backup image is unavailable. This is a warning ticket.
Detection Scenario	The robotics firmware auto-level process was unable to update one of the Robot Controller Board's flash parts.
Root Causes	One of the Robot Controller Board's flash partitions is bad.
Possible FRUs	Robot Assembly
Resolution	Perform “DR086: Resolve Robotics Degraded Flash Warning” on page 5-87.

T120: Robotics Y-Axis Motion Failure, Tape in Picker

Description	GUI Description: A Y-axis motion error occurred while the robot was moving a tape cartridge. Explanation: A y-axis motion error that cannot be considered a complete obstruction has been reported by robotics. Because a tape is in the picker, tape recovery must be a part of the resolution strategy. This ticket only occurs during a robotics move, not during a robotics get or put.
Detection Scenario	1. A specified move in the y-axis cannot complete. 2. Robotics firmware reports a y-axis error condition.

Root Causes	1. A physical obstruction in the path of the robot's motion. Examples include tape cartridges that are extending from the picker assembly or from a storage location, as well as tape cartridges or debris that may have collected on the floor of the library. 2. A large number of electrical hardware failures. Firmware or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuits, motor winding issues, etc.) 3. A relatively small number of mechanical hardware failures that do not result in the detection of a complete obstruction, but where motion control generates robotics firmware error codes (contamination or damage to encoder wheel, high friction, etc.).
Possible FRUs	• Y-carriage Assembly (if Model 1 robot is installed) or Robot Assembly (if Model 2 robot is installed) • Cable Spool
Resolution	Perform "DR088: Resolve Robotics Y-Axis Motion Failure" on page 5-88.

T121: Robotics Y-Axis Motion Failure, No Tape in Picker

Description	GUI Description: A Y-axis motion error occurred, which does not seem to be the result of robotic obstruction. Explanation: A y-axis motion error that cannot be considered a complete obstruction has been reported by robotics. Because a tape is not in the picker, tape recovery is not necessary as part of the resolution strategy. This ticket only occurs during a robotics move, not during a robotics get or put.
Detection Scenario	1. A specified move in the y-axis cannot complete. 2. Robotics firmware reports a y-axis error condition.
Root Causes	1. A physical obstruction in the path of the robot's motion. Examples include tape cartridges that are extending from the picker assembly or from a storage location, as well as tape cartridges or debris that may have collected on the floor of the library. 2. A large number of electrical hardware failures. Firmware or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuits, motor winding issues, etc.) 3. A relatively small number of mechanical hardware failures that do not result in the detection of a complete obstruction, but where motion control generates robotics firmware error codes (contamination or damage to encoder wheel, high friction, etc.).
Possible FRUs	Robot Assembly
Resolution	Perform "DR088: Resolve Robotics Y-Axis Motion Failure" on page 5-88.

T122: Robotics X, Z, Theta Axis Motion Failure, Tape in Picker

Description	GUI Description: An X, Z, or Theta axis motion error occurred while the robot was moving a tape cartridge. Explanation: An x, z, or theta axis motion error that cannot be considered a complete obstruction has been reported by robotics. Because a tape is in the picker, tape recovery must be a part of the resolution strategy. This ticket may occur during a robotics move or during a robotics get or put.

Detection Scenario	1. A specified move in the x, z, or theta axis cannot complete 2. Robotics firmware reports an x, z, or theta axis error condition.
Root Causes	1. A physical obstruction in the path of the robot's motion. Examples include tape cartridges that are extending from the picker assembly or from a storage location, as well as tape cartridges or debris that may have collected on the floor of the library. 2. A large number of electrical hardware failures. Firmware or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuits, motor winding issues, etc.) 3. A relatively small number of mechanical hardware failures that do not result in the detection of a complete obstruction, but where motion control generates robotics firmware error codes (contamination or damage to encoder wheel, high friction, etc.).
Possible FRUs	Robot Assembly
Resolution	Perform “DR089: Resolve X, Z, Theta Axis Motion Failure” on page 5-88.

T123: Robotics X, Z, Theta Axis Motion Failure, No Tape in Picker

Description	GUI Description: An X, Z, or Theta axis motion error occurred, which does not seem to be the result of a robotic obstruction. Explanation: An x, z, or theta axis motion error that cannot be considered a complete obstruction has been reported by robotics. Because a tape is not in the picker, tape recovery is not necessary as part of the resolution strategy. This ticket may occur during a robotics move or during a robotics get or put.
Detection Scenario	1. A specified move in the x, z, or theta axis cannot complete 2. Robotics firmware reports an x, z, or theta axis error condition.
Root Causes	1. A physical obstruction in the path of the robot's motion. Examples include tape cartridges that are extending from the picker assembly or from a storage location, as well as tape cartridges or debris that may have collected on the floor of the library. 2. A large number of electrical hardware failures. Firmware or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuits, motor winding issues, etc.) 3. A relatively small number of mechanical hardware failures that do not result in the detection of a complete obstruction, but where motion control generates robotics firmware error codes (contamination or damage to encoder wheel, high friction, etc.).
Possible FRUs	1. Picker Assembly (if Model 1 or Model 2 robot is installed) 2. Robot Assembly (if Model 2 robot is installed) 3. Cable Spool
Resolution	Perform “DR089: Resolve X, Z, Theta Axis Motion Failure” on page 5-88.

T124: Robotics Hardware Error - RCB

Description	This ticket occurs with **Model 2** robots only. GUI Description: A servo hardware error has been isolated to the robot controller board.

Detection Scenario	Robotics firmware reports a specific hardware error identifying the Robot Controller Board as the source.
Root Causes	Electrical hardware failure.
Possible FRUs	1. Robot Assembly 2. Cable Spool
Resolution	Perform "DR090: Resolve Robotics Hardware Error - RCB" on page 5-88.

T125: Robotics Hardware Error - Picker

Description	GUI Description: A servo hardware error has been detected in the picker mechanism. Explanation: A servo hardware error has been isolated to the robotics picker mechanism..
Detection Scenario	Robotics firmware reports a specific hardware error identifying the Picker assembly electronics as the source. .
Root Causes	Electrical hardware failure.
Possible FRUs	• Picker Assembly (if Model 1 or Model 2 robot is installed) • Robot Assembly (if Model 2 robot is installed)
Resolution	Perform "DR091: Resolve Robotics Hardware Error - Picker" on page 5-88.

T126: Robotics Hardware Error - Scanner

Description	GUI Description: A hardware error has been isolated to the barcode scanner. Explanation: A hardware error has been isolated to the robot's scanner device.
Detection Scenario	Robotics firmware reports a specific hardware error identifying the Imager component of the Picker assembly as the source.
Root Causes	1. Obstructions in the view path of the robot Imager. 2. Electrical hardware failure.
Possible FRUs	• Picker Assembly (if Model 1 or Model 2 robot is installed) • Robot Assembly (if Model 2 robot is installed)
Resolution	Perform "DR092: Resolve Robotics Hardware Error - Scanner" on page 5-89.

T127: Robotics Communication Error

Description	This ticket occurs with **Model 2** robots only. GUI Description: The library controller firmware lost communication with the robotics subsystem. Explanation: The library is not able to communicate with the Model 2 robotics subsystem. This ticket is generated if the library had previously established a communication link with the robotics subsystem, but that link has now been lost and cannot be reestablished.
Detection Scenario	The library firmware did establish communication with the robotics subsystem but encountered a communication failure during operation and communication could not be reestablished.

Root Causes	1. Damaged module terminator or module-to-module cable with bent or broken pins. 2. An intermittent door-open condition disconnecting power from the robot. 3. A cable spool or connection problem. 4. A picker assembly hardware failure. 5. A Y-carriage assembly connection problem. 6. A robot controller board hardware or software failure. 7. An LCB serial communication link failure.
Possible FRUs	• Cable Spool • Robot Assembly (replace entire unit)
Resolution	Perform "DR093: Resolve Robotics Communication Error" on page 5-89.

T128: Incompatible Robot Installation

Description	GUI Description: The library control firmware detected that an incompatible robot is installed. Explanation: The library has an incompatible robot installed. This may happen when a GA-style (Model 1) robot is replaced with the Model 2 robot, or vice versa.
Detection Scenario	Library firmware detects a change in robot model, which is incompatible with the current library configuration.
Root Causes	The robot was replaced with an incompatible robot type.
Possible FRUs	• Robot Assembly
Resolution	Perform "DR094: Resolve Incompatible Robot Installed" on page 5-89.

T129: Drive Sled Firmware Image Error

Description	GUI Description: Drive sled firmware cannot be auto-leveled due to a missing or corrupt drive sled firmware image. Explanation: During an attempt to autolevel the drive sleds, the library detected a missing or corrupt UDS.lif (drive sled firmware) file.
Detection Scenario	Main Library Firmware that controls and performs drive sled firmware updates detects that the drive sled firmware update file is missing or corrupted.
Root Causes	The drive sled firmware update file is missing or corrupted.
Possible FRUs	Library firmware
Resolution	Perform "DR095: Resolve Drive Sled Auto-level Failure" on page 5-90.

T130: Tape Drive Cleaning Failure

Description	GUI Description: A tape drive was cleaned but continues to request cleaning. Explanation: After a drive was cleaned and the cleaning tape was removed from the drive, the drive continues to request cleaning.
Detection Scenario	A drive continues to request cleaning after successful cleaning cycles have been applied.

Root Causes	Tape drive malfunction.
Possible CRUs	Drive Sled.
Resolution	Perform “DR096: Resolve Drive Cleaning Failure” on page 5-90.

T132: Hardware Clock Failure

Description	GUI Description: The hardware real-time clock (RTC) has failed. The library system time may appear to be set correctly, but accurate time will be lost following a power cycle or reboot. Explanation: While setting the library time, the library detected an error in the hardware real-time clock (RTC). This type of error will allow the library system time to be changed, but the time will not be set correctly following a power cycle or reboot.
Detection Scenario	Main library firmware determined that setting the hardware clock failed, though the system time may appear to have been set correctly.
Root Cause	The hardware clock on the LCB has failed.
Possible CRUs	LCB
Resolution	Perform “DR098: Resolve Hardware Clock Failure” on page 5-90.

T133: Barcode Label Mapping Failure

Description	GUI Description: The library control firmware cannot map barcode labels to respective slots during an inventory operation. Explanation: The library is attempting to map barcode labels during inventory and is being prevented from doing so because one or more barcode labels are improperly attached, or a magazine is improperly seated/installed.
Detection Scenario	The library cannot complete an inventory and there are no indications of hardware failure.
Root Causes	1. Obstructions in the view path of the robot Imager. 2. Improper installation of magazine(s). 3. Improper barcode label on tape cartridges. 4. User interface operations were being performed while the robot was scanning barcode labels.
Resolution	Perform “DR099: Resolve Barcode Label Mapping” on page 5-90.

T134: Barcode Scanner Malfunction

Description	GUI Description: The library barcode scanner cannot read any barcode labels. Explanation: The barcode scanner is unable to detect target information. The barcode scanner cannot detect any barcodes within the library.
Detection Scenario	The library was unable to detect any barcodes when scanning target columns at start up.
Root Causes	1. Barcode scanner illumination is insufficient. 2. Barcode scanner view is obscured (blocked). 3. Barcode scanner has failed.

Possible FRU Replacements	1. Picker Assembly 2. Cable Spool
Resolution	Perform "DR100: Resolve Barcode Scanner Malfunction" on page 5-91.

T135: Tape Drive Type Change

Description	GUI Description: An assigned tape drive has been replaced with a tape drive of a different type. Explanation: A tape drive that is assigned to a partition has been replaced with a tape drive of a different type, where *type* is defined by the tape drive's vendor, generation and interface. This RAS ticket is generated to notify the user of the tape drive type change.
Detection Scenarios	1. Installation of a tape drive into a library drive slot triggers the library to discover it. 2. Boot up causes the library to physically discover any tape drive that is electrically connected in the system.
Root Cause	End user replaced an assigned tape drive with a tape drive of a different generation, interface or vendor.
Possible CRU	Drive Sled
Resolution	Perform "DR101: Resolve Tape Drive Type Change" on page 5-91.

T136: Robotics Z Axis Motion Failure

Description	GUI Description: An unrecoverable robot motion failure has occurred in the z-axis. Explanation: An unrecoverable motion failure occurred in the z-axis. Because a tape cartridge may or may not be present in the picker, tape recovery must be part of the resolution strategy.
Detection Scenarios	A specified motion in the z-axis cannot complete.
Root Cause	1. Any of a large number of electrical hardware failures. Code or hardware detects that motion control is not occurring properly (encoder issues, motor driving circuit issues, motor winding issues, cable connections issues, etc.). 2. A relatively small number of hardware errors that do not result in complete obstruction but where servo control does not appear to be normal.
Possible FRU Replacement	• Picker Assembly
Resolution	Perform "DR102: Resolve Robotics Z Axis Motion Failure" on page 5-91.

T137: Display Assembly Communication Failure

Description	GUI Description: A local display assembly communication failure has been detected. Explanation: The library encountered an error which appears to be caused by a communication link failure to the display assembly (DIEB) board.

Detection Scenarios	1. Failed I2C communication with the DIEB board. 2. Failed GPIO communication with the DIEB board.
Root Cause	1. Board level hardware failures. 2. Display not plugged in. 3. Cable failure or not plugged in. 4. LCB failure. 5. Rare power supply problem where too much voltage is transferred to the display.
Possible CRUs	• LCB • Display/Door and I/E PCB
Possible FRU Replacement	• Module (EM or CM) • Display (Operator Panel)
Resolution	Perform "DR103: Resolve Display Assembly Communication Failure" on page 5-92.

T139: Robotics Communication Loss

Description	This ticket occurs with **Model 1** robots only. GUI Description: The library controller firmware lost communication with the robotics subsystem. Explanation: The library has lost communication with the Model 1 robotics subsystem. This ticket is generated if the library had previously established a communication link with the robotics subsystem, but that link has now been lost and cannot be reestablished.
Detection Scenarios	The library firmware did establish communication with the robotics subsystem but encountered a communication failure during operation and communication could not be reestablished.
Root Cause	1. An intermittent door-open condition disconnecting power from the robot. 2. Damaged module terminator or module-to-module cable with bent or broken pins. 3. A cable spool or connection problem. 4. A picker assembly hardware failure. 5. A Y-carriage assembly connection problem. 6. An LCB serial communication link failure.
Possible CRUs	• Robot Assembly (replace entire unit)
Possible FRU Replacement	• Module Terminators and Module-to-Module Cables • Cable Spool
Resolution	1. Perform "DR093: Resolve Robotics Communication Error" on page 5-89. 2. Check to see if there is a main door open condition, which may be caused by an open door or a defective or loose module terminator or module-to-module cable. 3. Inspect the module terminators and module-to-module cables for loose connectors or damage (bent or broken pins). If damaged, replace the part. Reseat the terminators and cables.

T141: Unknown Picker Calibration Offsets

Description	GUI Description: Library firmware is unable to read robotics picker's calibration offsets. Explanation: The picker's EEPROM/FLASH that contains calibration offset values required for proper picker calibration and fiducial size evaluation, does not contain valid calibration offsets. If such offsets are missing and cannot be read, the robot will fail calibration and cannot operate.
Detection Scenarios	Attempts to read the stored calibration offsets from EEPROM/FLASH of the robotics controller board failed.
Root Cause	1. Defective EEPROM/FLASH area to read offsets. 2. Calibration offsets not stored during manufacturing process.
Possible FRU Replacement	Picker Assembly
Resolution	Perform “M2 Picker Assembly” on page 7-82 for M2 picker or “Original Picker Assembly” on page 7-58.

T142: Robotics Y-Axis Hardware Failure

Description	GUI Description: The robotic Y-axis gear failed to perform proper motion. Explanation: Movement of the robot assembly along the Y-axis is accomplished using the Y-carriage assembly, which contains the Y-motor. The Y-motor has a gear that is attached directly to the motor shaft. Failure or degradation of this Y-motor gear is the failure mode for this ticket.
Detection Scenarios	Robotics firmware reports a specific hardware error identifying the Y-carriage assembly or Y-Motor hardware as the source.
Root Cause	Failure or degradation of the Y-motor gear that drives the robot assembly along the y-axis.
Possible FRU Replacement	Y-carriage Assembly (if Model 1 robot is installed) or Robot Assembly (if Model 2 robot is installed)
Resolution	Perform “M2 Robot Assembly” on page 7-77 for M2 robot assembly or “Removing the Y-axis/Picker Assembly” on page 7-54 and “Replacing the Y-axis/Picker Assembly” on page 7-56 for the Model 1.

T143: Unlabeled Cartridge Detected

Description	GUI Description: An unlabeled tape cartridge or unreadable tape cartridge barcode label has been detected. Explanation: During library initialization, or after a main door closure event, the library performs an inventory of the entire library. An inventory of respective magazines is also performed each time an I/O station closes. These inventory operations use scanner reported barcode label information to determine element full and empty status. If the library is configured to perform an "EMPTY SLOT" detection, actually using the teach sensor to determine if any empty element may hold a cartridge that may not have a scanner readable barcode label attached, and such an unlabeled cartridge is found, this RAS ticket is generated to alert of such condition and allow the user to correct the issue. The system will be able to report full status and also allow the cartridge to be moved but any cartridge label reference with be listing "NO_LABEL" on the user interface screens and a SCSI READ ELEMENT STATUS response will not list label/volser information at all. A RAS ticket will be generated upon the first occurrence of such unlabeled cartridge detection; a separate ticket will not be generated for each tape found.
Detection Scenarios	During "touch" inventory, the teach sensor indicates cartridge presence but the scanner was unable to read the cartridge barcode label.
Root Cause	A tape cartridge does not have a barcode label attached, or the barcode label is damaged and unreadable.
Possible FRU Replacement	None
Resolution	Remove and replace the unlabeled tape cartridge.

T144: I/O Station Door Sensor Stuck

Description	GUI Description: An I/E (or I/O) station sensor switch is reporting incorrect sensor status and may be stuck. Explanation: The library controller detected that an I/O station sensor is not reporting a valid status. The problem may be caused by a stuck sensor in the I/O station lock assembly with a control module or expansion module. Door open and close state changes are not detected reliably, and premature I/O station teach operations may occur, or no teach and inventory operation may be triggered at all.
Detection Scenarios	When processing a state change on either of the two sensor switches, if the sensor switch causing the interrupt is activated, the opposite sensor switch is checked to see if it is activated too. If they are both active, one sensor switch is stuck.
Root Cause	• A sensor switch is obstructed by foreign material. • A sensor switch is binding or sticking. • A sensor switch is broken.
Possible FRU Replacement	I/O Station Lock Assembly
Resolution	See “DR025: Resolve Stuck I/O Station Sensor” on page 5-69.

T145 - Media Removal Notification

Description	The library detected an expected cartridge removal from a configured I/E (or I/O) area element.

Explanation	The library is configured for Media Security Notification and detected an expected removal of media. Media removal is expected whenever an exported cartridge has been physically removed by an operator from an I/O area element.
Detection Scenarios	After I/O elements have been inventoried, the library determined that a previously exported cartridge is no longer present.
Root Causes	An exported cartridge has been removed from the library.
Resolution	Perform “DR106 - Resolve Media Security Notification” on page 5-92.

T146 - Media Removal Warning

Description	The library detected an unexpected cartridge removal from the library.
Explanation	The library is configured for Media Security Notification and detected an unexpected removal of media. Media removal is not expected if the cartridge is no longer found in previously configured storage and drive elements, as well as the medium changer (picker) element itself. Media removal is also not expected from configured I/O area elements, unless the tape cartridge had been moved to such element by robotic motion.
Detection Scenarios	After an inventory operation, the library determined that a previously configured, but not exported, tape cartridge is no longer present.
Root Causes	A tape cartridge has been removed from the library without having been properly exported by the robot.
Resolution	Perform “DR106 - Resolve Media Security Notification” on page 5-92.

T149 - Key Path Diagnostic Delay

Description	The library is unable to initiate a background Key Path Diagnostic to an EKM server.
Explanation	The library attempted to perform a Key Path Diagnostics to an EKM server, but a tape drive has not been available with the proper prerequisites, such as being ready and unloaded. This ticket conveys the fact that the test could not be performed within the selected test time period which is determined by the configured test time interval multiplied by the configured test warning threshold.
Detection Scenarios	The library attempted to perform a Key Path Diagnostics but did not succeed in initiating the test within the configured test warning threshold due to a tape drive not being available to allow the test to run.
Root Causes	• IBM LTO tape drive or drives are still loaded, preventing the library from initiating a Key Path Diagnostics via a tape drive. • IBM LTO tape drive or drives are not ready, preventing the library from initiating a Key Path Diagnostics via a tape drive.
Resolution	Perform “DR118 - Resolve EKM Path Diagnostic Delay” on page 5-94.

T153: Drive Control Failure

Description	GUI Description: A tape drive failed to enable or disable Library Managed Encryption (LME). Explanation: The drive sled controller firmware commanded the drive to enable or disable library managed encryption for the drive, yet the drive failed to perform the requested operation.

Detection Scenarios	• Library control firmware received a drive sled event, E_DDC_LME_ENABLED, indicating that the tape drive did enable Library Managed Encryption, but the library requested that the drive configure for Application Managed Encryption (AME). • Library control firmware received a drive sled event, E_DDC_LME_DISABLED, indicating that the tape drive did not enable for Library Managed Encryption, but the library requested that the drive configure for LME.
Root Cause	Library control firmware was informed by drive sled of a tape drive command failure.
Possible FRU Replacement	Drive Sled
Resolution	Perform "DR110: Resolve Drive Encryption Control Failure" on page 5-93.

T154: Drive Encryption Monitoring Warning

Description	GUI Description: A tape drive request to initiate a library managed encryption key exchange did not provide the required request details to service the encryption key exchange request. Explanation: The drive sled controller firmware suspended Encryption Service Request (ESR) monitoring of the tape drive, due to the tape drive having indicated an ESR, but when the drive sled controller firmware requested details from the tape drive, no data was provided. If this issue is encountered twice in a row, ESR monitoring will be suspended for the duration of the drive mount session and will be re-enabled when a new tape cartridge is mounted.
Detection Scenarios	Library control firmware received a drive sled event indicating that the tape drive reported an ESR, but details are not reported by the tape drive.
Root Cause	Tape drive firmware may incorrectly report an ESR when none is outstanding, or have a valid ESR, but not have the proper encryption key request details available upon drive sled controller request.
Possible FRU Replacement	Drive Sled
Resolution	Perform "DR111: Resolve Drive Encryption Service Request Monitoring" on page 5-93.

Diagnostic Resolutions

Diagnostic Resolutions are accessed via wizard screens on the Operator Panel. When an Operator Intervention occurs, a diagnostic resolution wizard is available to help you resolve the problem.

Important: It is recommended that Service Action Tickets not be allowed to accumulate in the Operator Intervention reports. After an incident has been resolved or repaired, the Service Action Ticket should be closed.

DR001: Resolve Picker Cartridge Presence

Problem:
The library has a tape in the Picker Assembly but cannot recover without user intervention to remove the tape.

Troubleshooting Steps:

1. Take all library partitions offline.
2. Open the library main access doors.
3. Rotate the picker assembly by hand so that the opening faces the drives.
4. Use the gear thumbwheel on the right side of the picker assembly base closest to you to manually drive the tape cartridge out of the picker assembly towards the tape drives.
5. Remove the tape cartridge and close the library main access doors. Wait for the library to initialize.
6. Insert the tape into the appropriate logical library.
7. If a tape cartridge was removed, continue operations.
8. If there was no tape cartridge in the picker assembly, it is most likely that the tape presence sensor in the picker assembly is malfunctioning. Contact Service for assistance.
9. Choose one of the following options:
   - Select **Close** to close the ticket.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

If there is no cartridge in the Picker when you investigate, it is likely that the cartridge present sensor in the Picker is malfunctioning.

Remove and replace the Picker. Refer to "M2 Picker Assembly" on page 7-82.

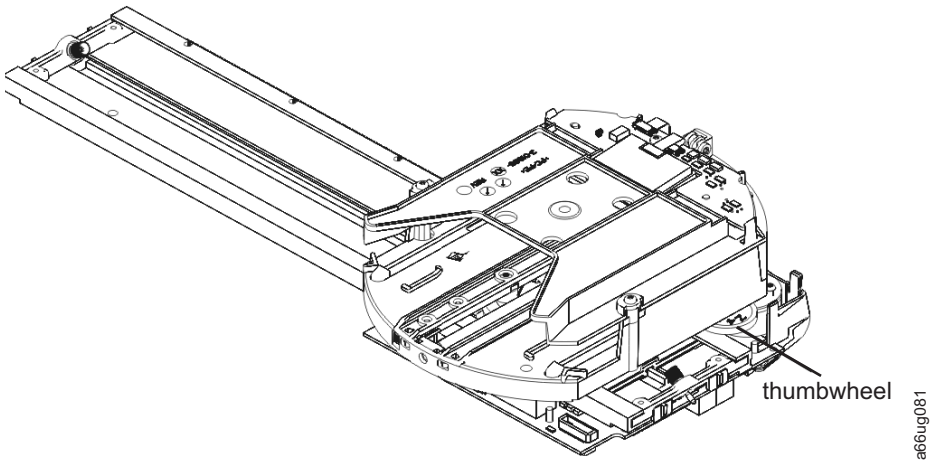

Figure 5-1. Gear thumbwheel

DR002: Resolve Tape Cartridge Recovery

Problem

The library robot has failed during a move media operation. The tape cartridge must be manually recovered before operations can continue.

Troubleshooting Step:

1. Open the main Access Door(s) and find the cartridge. It may be stranded between the Picker and the source or destination of the move.
2. Recover the cartridge.
3. Inspect slots for any obstruction.
4. Close the main access doors and wait for the system to complete initialization.
5. Use the **Tools** > **Service** > **Library** > **Robot Test** to verify if the robot is operational.
   - If the test fails, refer to Chapter 1, "Start Service," on page 1-1.
   - If the test passes, Close the Operator Intervention message and continue operations and monitor for reoccurrence.
6. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR003: Resolve Drive Eject Failure

Problem:

The library received a request to unload and eject a tape cartridge from a tape drive but the operation failed.

There are two cases to consider:

- The tape drive is or was still busy servicing host commands, or
- the tape drive failed to physically unload and eject the tape cartridge.

Troubleshooting Steps:

1. View the ticket details to determine if the tape drive was busy reading or writing data.
2. If the drive was busy servicing host commands, wait for the host application to finish drive operations; then repeat the command request to unload the tape drive.
3. If the drive was not busy servicing host commands, retry the failing command request.
4. If the requested command succeeds, observe for future occurrences and contact Service if the issue repeats.
5. If the requested command fails, open the library main access door(s) and use the drive pushbutton on the front of the drive to initiate a tape cartridge eject operation. Press and hold the button continuously for 10 seconds. If the tape is ejected, leave the cartridge in the tape drive, close the library access doors and continue operation. Observe for future occurrences of such issue and contact Service if the issue repeats.
6. If the drive fails to unload and eject the tape cartridge, contact Service for assistance.
7. You have three options:
   a. Close the Operator Intervention now.
   b. Exit to leave it open for future troubleshooting.
   c. Return to the Diagnostic Resolution now.

DR004: Resolve Full Destination Element

Problem:

The library attempted to put a cartridge in a drive, storage, or the I/O Station. The destination location appears to be blocked or partially blocked. The library has successfully returned the cartridge to the source location.

Troubleshooting Steps:

1. Identify the coordinate provided in the Details of the ticket.
2. Open the library bulk load doors *(Access Doors)* and locate the problem location.
3. Inspect it for the presence of unlabeled media, or other contamination or damage that prevented the library robot from placing the cartridge.

DR005: Resolve Motion Failure

Problem:

The Picker has failed to perform a motion. The detected failure is likely to be a genuine hardware failure.

Troubleshooting Step:

1. Open the I/O Station door then the Access Door and look for any obvious problems such as unplugged cables or damage to the picker assembly.
2. Remove any tapes from the Picker or from the path of the Picker.
3. Close the doors and wait for the system to complete initialization.
4. Select **Tools** > **Service** > **Library** > **Robot** to determine if the failure is permanent.
   - If the test fails, refer to Chapter 1, "Start Service," on page 1-1.
   - If the test passes, monitor for reoccurrence.

DR006: Resolve Unload Timeout

This tape drive diagnostic requires a blank, scratch cartridge.

Problem:

A drive is suspected of having a problem.

Troubleshooting Steps:

1. From the Operator Panel, select **Tools** > **Service** > **System**.
2. Touch **Yes** to take all logical libraries OFFLINE.
3. Select **Drives**.
4. Select **Drive Tests**.
5. Select **Wrap Test**.
6. Select the interface to be tested.
7. Select the module and drive to be tested.
8. Place a scratch cartridge in the top slot of the top I/O Station, then close the I/O door.
9. When the **Assign I/O** screen is displayed, touch **System**, then **Apply** to continue.
10. Attach the wrap tool to the Fibre Channel port on the back of the drive.
11. Select the drive test to be performed. The cartridge will be loaded and the test will begin.
12. The scratch cartridge will be returned to the top slot of the top I/O Station and the results of the test will be displayed.
13. Touch **Exit** to return to the **Library Verify** screen.
14. Touch **Back** to return to the **System Diagnostics** screen.
15. Touch **Back** to return to the **Library Offline** screen.
16. Touch **No** to return to the **Service Menu** screen.
17. Touch **Exit** to return to the **Tools** menu.
18. Touch the **Operations** tab, then touch the **Logical Library Mode** button to bring the logical libraries back ONLINE.

DR007: Resolve Barcode Scanner Issue

Problem:

The library has failed to scan one of the following system bar code labels:

- system serial number
- world wide name
- drive identification label
- module serial number

This problem IS NOT associated with failure to read a tape cartridge bar code label.

Troubleshooting Steps:

1. Select **Tools** > **Service** > **Library** > **Barcode Test** to help isolate the problem and determine if it is intermittent.
2. Run the test several times and note the results.
   - If the test passes, the failure is most likely with a particular bar code label.
   - If the test fails, the failure is most likely with the Picker Assembly that contains the bar code scanner.

DR008: Resolve Stuck I/O Station Interrupt

Problem:

The library control firmware receives continuous I/O station door state change events. Actual door open and closure state changes can still be detected and cartridge inventory operations will still perform properly, but library performance is affected.

Troubleshooting Steps:

1. Close the RAS ticket and power off the library.
2. Inspect the top and bottom library module terminators for bent or shorted connector pins. Re-attach if no problem is found.
3. If the library consists of multiple modules, inspect all module-to-module cables for bent or shorted connector pins. Re-attach if no problem is found.
4. If a defective connector is found, call Service for part replacement.
5. If no issue is found, power on the library and wait for the library to initialize. Open and close each I/O station door. If the RAS ticket is displayed again, contact Service.

DR009: Resolve AC Failure

Problem:

The facility AC power appears to be failed on a power supply. This can be the result of the facility power actually being OFF, the power switch on the power supply being turned OFF, or an actual failure in the power supply.

Troubleshooting Steps:

1. Check the facility AC power and make sure the power supply is properly seated and the power switch is on.
2. Inspect all module terminators for any broken or bent pins.
3. If the library consists of multiple modules, inspect all module-to-module cables for any broken or bent pins.
4. If the facility AC power and the power supply power switch are OK, see “Power Supply (Primary and Redundant)” on page 7-51.

DR010: Termination and Connectivity Diagnostic

Problem:

The library requires two terminators to be plugged into two specific ports on the rear of the library in order to automatically detect its configuration. In a multi-module system, these terminators are placed in the expansion modules at the very top and bottom of the vertical stack. In addition, cables must connect all modules together.

Troubleshooting Steps:

Are the terminators and all module to module cables plugged in properly?

- **No** - You reported that the cables and terminators were not plugged in correctly. Select Continue, then power down the library, plug the cables in and power the library back on. When the library powers up, it should detect the presence of the cables and terminators and properly configure itself. The library has determined that the problem is fixed and it will close the ticket.
- **Yes** - Place both terminators on the CM to begin isolating the problem. You may back up or proceed with the Self Test.
  - **Self Test Failed** - Inspect the module connectors and terminators for bent or broken pins. Contact Service to order replacement terminators. Refer to your product documentation to determine how to order parts.
  - **Self Test Passed** - Self Test passed. Continue to isolate the failure by plugging the terminator into the next upper expansion module and connecting the modules with the module-to-module cable. Once the terminators and cables are installed, perform the self test again. If there is no additional upper expansion module, select the **Next** button.
    - **Self Test Failed** - Inspect the module connectors and module-to-module cables for bent or broken pins. Contact service to order replacement cable or expansion module. Refer to your product documentation to determine how to order parts.
    - **Self Test Passed** - Upper expansion module Self Test passed or there was no upper expansion module. Continue to isolate the failure by plugging the terminator into the first lower module and installing the module-to-module communication cable. Once the terminator and cables are installed, perform the Self Test again.

      If there is no lower module, select the **Next** button.
      - **Self Test Failed** - Self Test failed. Contact IBM Service to order replacement cable or lower expansion module. See product documentation to determine how to order parts.
      - **Self Test Passed** - Proceed to next step.
      - The library must be power cycled for the module configuration to be fully invoked as the intended operating configuration.

DR011: Resolve I/O Station Lock/Unlock Failure

Problem:

An I/O station lock failed to operate properly. It is possible for a user to interfere with lock and unlock operations by trying to open/close an I/O station door while the lock is attempting to engage or disengage.

Troubleshooting Steps:

To proceed with troubleshooting the library should be taken out of service.

- If the user opened or closed the I/O station at the time the problem was reported, close this operator intervention message and retry operations.
- If the problem is reported again, contact Service.
- If there was no user interaction with the I/O station at the time the problem was reported, defective hardware is likely. Contact service to resolve the problem.
- Choose one of the following options:
  - Select **Close** to close the ticket now.
  - Select **Exit** to leave the ticket open for future troubleshooting.
  - Select **Back** to return to the Diagnostic Resolution.

It may take several minutes to achieve offline state for all partitions depending on host commands in progress.

Do you want to set all logical libraries to offline at this time?

- **No** - You have elected to troubleshoot at a later time. Ticket will remain open.
- **Yes** - Open all I/O Station doors. Select Self Test to trigger the library to verify all doors are open.
  - **Self Test Failed** - Test failed. Door *X* is not detected open. Replace I/O Station lock assembly.
  - **Self Test Passed** - Door open test passed.

    Close all I/O Station doors. Select Self Test to trigger the library to verify all I/O Station doors are closed.
    - **Self Test Failed** - Test failed. Door *X* is not detected closed. Replace I/O Station lock assembly.
    - **Self Test Passed** - Door closed test passed.

      Select Self Test to trigger the library to verify that all I/O station locks can be locked and opened.
      - **Self Test Failed** - Test failed. Lock *X* is not opening and closing properly. Replace I/O Station lock assembly.
      - **Self Test Passed** - Lock test passed.

        Attempt to open all I/O Station doors to confirm that doors are locked.

        Did any of the doors open?
        - **Yes** - I/O Station door *X* opened when the lock should have prevented it. Replace I/O Station lock assembly.
        - **No** - Doors locked shut test passed.

          The system will now attempt to locate the I/O Station magazines with the robotics.
          - **Self Test Failed** - I/O Station magazine *X* in I/O Station *Y* cannot be properly calibrated. Replace I/O Station lock assembly and magazine.
          - **Self Test Passed** - All self tests have passed. The original problem has been resolved.

            Ticket has been closed.

            Monitor for reoccurrence.

DR012: Resolve Drive Tape Alert 32 - Host Interface

Problem:

A tape drive has detected and reported a problem with its host interface connection. This can be caused by a loose or disconnected cable, bad termination, or other FC, SAS, or SCSI communication issues.

Troubleshooting Step:

1. If the drive is SCSI:
   - check for proper termination
   - check cable length meets SCSI limits
   - check host and drive connectors for bent or broken pins
   - secure host and drive connectors
2. If the drive is Fibre Channel:
   - check cable connections are secure
   - check for broken or pinched cables
   - check for cable bend radius too sharp
   - check cable connections are clean
3. If the drive is SAS:
   - Check Cable connections are secure.
   - Check for broken or pinched cables.
   - Check cable connections are clean.
4. Check all hardware components between host and drive are communicating correctly.
5. Check host HBA and components are communicating correctly.
6. If problem remains unresolved, contact your next level of support.

DR014: Resolve Write-Protected Tape Cartridge

Problem:

A back up application attempted to write data to a write protected or WORM cartridge.

Troubleshooting Step:

Determine whether the cartridge should be write protected or not.

If not, export the cartridge via your back up application and correct the problem by manually changing the write protect switch on the cartridge.

If the cartridge is correctly set as a "read only" tape, investigate your host application to determine why a write was attempted.

DR015: Resolve Unsupported Tape Format

Problem:

A cartridge that is not a correct format has been loaded into a drive. There are several common scenarios:

1. FMR update cartridge loaded as a data cartridge
2. Cleaning cartridge loaded as a data cartridge
3. Data cartridge loaded as a FMR cartridge
4. Data cartridge loaded as a cleaning cartridge
5. Wrong generation of tape in a drive.

Troubleshooting Step:

If the cartridge was loaded to the drive via the Library GUI, remove the cartridge via the library **Operations** > **Media** > **Move** function. Insert the proper type of cartridge for the desired operation and continue.

If the cartridge was loaded to the drive via a host application, remove the cartridge via the host application. Insert the proper type of cartridge for the desired operation and continue.

DR016: Resolve Prevent/Allow Media Removal

Problem:

The library has been commanded to perform a cartridge move from a drive, but the drive is currently preventing any media removal due to having received a SCSI Prevent/Allow Media Removal command to prevent a tape cartridge removal. The library cannot unload and eject the tape cartridge from the drive until the host application issues a SCSI Prevent/Allow Media Removal command to allow a tape cartridge unload operation.

Troubleshooting Step:

Determine which host currently has a prevent media removal set. Use the host application or OS functionality to clear the Prevent mode.

DR018: Resolve Drive Cleaning Requirement

Problem:

A drive has reported that it requires cleaning. The drive cannot be used for normal operations again until it is successfully cleaned. This problem should be addressed differently based on your system setup.

Troubleshooting Steps:

There are two cases to consider:

1. Library-controlled or host-controlled cleaning is enabled.
   - Prior to the tape drive requesting cleaning, the cleaning process should have been triggered already when the tape drive recommended cleaning. However, since the tape drive is now requesting to be cleaned, a valid, non-expired cleaning tape may not have been available for library initiated or host controlled cleaning. Verify that cleaning tapes are properly configured and not expired.
   - Perform a manually initiated cleaning operation for the tape drive as specified in the user documentation.
2. Library-controlled automatic cleaning is disabled.

   Since automatic library initiated tape drive cleaning operations are not enabled, perform a manually initiated drive cleaning operation for the tape drive as specified in the user documentation. Note that in the case of RAS ticket “T045: Drive TapeAlert 20 - Clean Now” on page 5-22, the drive may require multiple drive cleaning operations.
3. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR019: Resolve Open Access Door

Problem:

A library main access door appears to be open. Either an access door is opened, or module termination is interrupted.

There are two basic scenarios to recover from:

1. Door open DID NOT interrupt a library MOVE MEDIA.
2. Door open DID interrupt a library MOVE MEDIA.

Resolutions:

1. Door open DID NOT interrupt a library MOVE MEDIA.

   If the door opening was planned and performed when the Picker was idle, recovery consists of simply closing the door. The library will re-inventory and trigger back up applications to resynchronize inventory.

2. Door open DID interrupt a library MOVE MEDIA.

   If the door opening was not planned, MOVE MEDIA operations may have been interrupted. Check back up applications to make sure that no jobs have been interrupted. Follow the **Resolve** instructions for any other problems.

DR020: Resolve Library Inventory Mismatch

Problem:

The library has encountered a problem that indicates a mismatch between the library's physical and logical inventory.

Troubleshooting Step:

1. View the ticket details to determine any source and destination element locations.
2. Open a main access door and inspect the destination element for tape cartridge presence.
3. If a labeled tape cartridge is present, the robot is not reading that label reliably. Inspect the label, replace if needed and close the main access door to trigger an inventory of the library.
4. If the source element is empty, close the main access door to trigger an inventory of the library.
5. Wait for the library to initialize and then restart the host applications to continue operation.
6. If the robot does not inventory the library after the door is closed, contact Service for further assistance.
7. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR021: Contact IBM Service

This Operator Intervention requires technical assistance from IBM. Please contact an IBM Service Representative by phone or web to open a Service Request.

In the USA: 800-IBM-SERV (1-800-426-7378)

All other countries/regions: http://www.ibm.com

To open a Service Request online: http://www.ibm.com

At the direction of IBM Technical Support, you may be asked to perform the following functions:

- Capture Snapshot (From the Web User Interface, select **Service Library** > **Capture Library Log**
- Close Operator Intervention.

  You may select the **No** button to leave this problem open for future review.

DR022: Resolve Missing Power Supply

Problem:

A power supply is detected to be missing in the system. This is most likely caused by an actual removal of a power supply.

Troubleshooting Step:

If you have recently removed a power supply from the library, replace it and **Close** this Operator Intervention.

If you want to permanently remove a power supply, close this operator intervention and power cycle the library with the power supply removed.

If all power supplies appear to be present, see "Power Supply LEDs" on page 6-22.

DR023: Resolve Missing I/O Station Magazine

Problem:

An I/O Station has been closed with a cartridge magazine missing. The library can still perform most operations; however, any attempt to export a cartridge to this I/O Station location will fail.

Troubleshooting Step:

1. If the magazine was intentionally removed, the only action required is to close this operator intervention.
2. If the magazine was removed by mistake, open the I/O Station and reinstall the magazine. Close the operator intervention.
3. If the magazine was installed when this problem was detected, refer to "DR021: Contact IBM Service" on page 5-68.

DR024: Close I/O Door

Problem:

An I/O Station door is open but the library requires it to be closed to continue operation.

Troubleshooting Step:

Close the I/O Station door and close the Operator Intervention.

DR025: Resolve Stuck I/O Station Sensor

Problem:

The library control firmware detected an invalid I/O station door sensor state. Actual I/O station door closure events may be detected prematurely, resulting in premature I/O station calibration attempts and calibration failures, or may not be detected at all, skipping any calibration and inventory operations.

Troubleshooting Steps:

1. Identify the library module listed in the RAS ticket and open its I/O station door.
2. Close the RAS ticket.
3. Open the main access door to view the I/O Station Lock Assembly of the opened I/O station.
4. Inspect both I/O Station Lock Assembly sensor switches, located in the front and rear of the I/O Station Lock Assembly.
5. Look for obstructions or misalignment causing the rear sensor switch actuator lever to be held down.
6. Open and close the I/O Station Safety Door multiple times to view operation of the front sensor switch.
7. If no issue is found, or interference was identified and corrected, close the I/O station and main access door and wait for the library to complete initialization.
8. Open and close the I/O station door and verify that the I/O station is being calibrated and scanned.
9. If the I/O station is not being calibrated and inventoried, or the RAS ticket is displayed again, refer to "DR021: Contact IBM Service" on page 5-68.
10. Choose one of the following options:
    - Select **Close** to close the ticket now.
    - Select **Exit** to leave the ticket open for future troubleshooting.
    - Select **Back** to return to the Diagnostic Resolution.

DR026: Resolve Unsupported Module Configuration

Problem:

The library has detected a configuration of expansion module frames that is not supported by the current firmware. There are two possible scenarios:

- The configuration is valid and your system requires newer firmware to support the configuration.
- The configuration of EM's is not a valid configuration.

Troubleshooting Steps:

Contact IBM Technical Support to determine why your module configuration is not supported.

DR027: Resolve Unknown Library SN Label

Problem:

The library cannot read one of the module serial number labels but has already validated that the bar code scanning system is working properly. There are four likely scenarios:

1. Line of sight from the scanner to the module serial number bar code label is blocked by foreign material such as a media bar code label.
2. The module serial number bar code label is damaged and the bar code scanner can not read it reliably.
3. One or more module terminators or module-to-module cables has bent or broken pins.
4. The module terminators or module-to-module cables are not installed in the correct locations and exclude a module.

Troubleshooting Steps:

1. Power off the library and inspect all module terminators and module-to-module cables for any bent or broken pins. Contact Service to replace any damaged parts.
2. Ensure that the module terminators are connected to the extreme top and bottom connectors of the library and that the module-to-module cables are connected correctly per the library documentation.
3. Open the main library access doors and look for any damage to the module serial number. Check for obstructions in front of the module serial number barcode labels.
4. If no obvious foreign material is found, the module serial number is damaged and the EM or CM will need to be replaced. The library is not operational until it can successfully read the barcode label. Close the ticket and close all main access doors to allow the library ti initialize again.
5. If the issue reoccurs, contact service for possible CM or EM replacement.

DR028: Resolve Motion Obstruction

Problem:

The library robot has failed to perform a motion. It appears that the motion has been obstructed by a foreign object or a misplaced cartridge.

Troubleshooting Steps:

1. Open the main access door(s) and look for interference by the parking tab, any obvious foreign objects, or tape cartridges obstructing motion.
2. If this is a new installation, check for packing material and robot shipping posts, which are large plastic screws that protrude from the top of the robot. Make sure the Y-rails are secured properly and the robot is moving horizontally level along the Y-rails.
3. Look under the robot to make sure that there is no tape or other hidden obstruction on the floor of the library.
4. Verify the robot parking tab is in the unparked position and not interfering with the robot Y-axis travel.
5. Close the doors and wait for the System to complete initialization.
6. Use the **Tools > Service > System > Library > Robotics** to exercise the robot and verify that the obstruction is cleared.
   - If the test fails, refer to Chapter 1, "Start Service," on page 1-1 for further troubleshooting instructions.
   - If the test passes, the obstruction is cleared. Monitor for reoccurrence.

DR029: Resolve Drive Sled Communication Loss

Problem:

The system can no longer communicate with a drive sled.

There are a few scenarios that can create this problem.

1. A user removed a drive sled
2. A hardware failure that results in the drive appearing to be disconnected.

Troubleshooting Steps:

1. If the drive was intentionally removed, close this ticket.
2. Check for T021 tickets posted against other drives in the same module, if present. If other tickets exist, skip to step #7.
3. Close this ticket and remove and reseat the drive. Check the thumb screws on the drive to make sure they are tight and the drive is mounted flush to the library chassis.
4. If this ticket reappears, close it again and move the drive to an empty slot in the same module. If no ticket appears after this, contact Service to replace the chassis.
5. Otherwise, close the ticket and move the drive to an empty slot in an adjacent module, if applicable. Check for ticket recurrence.
6. If the ticket is posted yet again, contact Service for drive replacement If the ticket is posted yet again, contact Service for drive replacement.
7. Check the power supply in the back of the module to verify that it is turned on and plugged in properly. If not, correct the problem, close all the T021 tickets for the module, and verify that they do not get posted again.
8. If the tickets do reappear, check further for T021 tickets posted against drives in other modules, if applicable. If there are none, contact Service for chassis replacement.
9. If T021 tickets do exist for drives in other modules, close them, turn off the library, remove and reseat the LCB, and turn the library back on. Check to see if any T021 tickets reappear.
10. If so, then check for other causes. There are other problems such as T066- Drive Power Fuse Blown or a module terminator or module-to-module cable with bent or broken pins that can cause communication loss. Resolve these problems, if found.
11. If not, contact service for further assistance.

DR030: Resolve Drive Load Failure

Problem:

The robot was unable to load a tape drive. The robot motion completed normally but the drive did not report that it successfully loaded the tape. The problem may be caused by defective drive hardware or a defective picker mechanism.

There are two possible scenarios that can lead to this problem:

1. The drive hardware is not functioning properly.
2. The robot hardware is not functioning properly.

Troubleshooting:

1. The problem is most likely isolated to the specific drive referenced under the Details button. However, check for the same problem being reported for other drives in the system.
2. If this same problem is reported on multiple drives, replace the Picker. Refer to “M2 Picker Assembly” on page 7-82.
3. If this problem is isolated to an individual drive, replace the drive. Refer to “Drive Sled” on page 7-42.

DR031: Resolve Robot Initialization Failure

Problem:

During a power ON or after closing library main access doors, the robot did not initialize properly.

A common cause for this problem is an unplugged cable that leads to the robot. Other permanent hardware failures that result in loss of connection to the robot can also be a root cause.

Troubleshooting Steps:

1. Open the library main access doors. This will allow access to the robot and remove power from the robot. Check for any obvious disconnected cables leading to the robot.
2. If any disconnected cables are discovered, plug them in and close all main access doors. The robot automatically attempt to initialize.
3. If no problem is found or the robot still fails, contact IBM Technical Support.

DR032: Resolve Drive Control Path Failure

Problem:

A control path to a library has failed. It is likely that a drive sled failure is being reported as a separate problem.

It may be possible to reestablish the control path by resetting the drive sled. In libraries with more than one drive you have the option to use an alternate drive as the control path if your host connection architecture permits it.

Changing the control path can be a temporary work around until the original drive problem is corrected OR a permanent change in your setup.

Procedure:

1. Reset the drive. For more information, refer to"Resetting a Drive" on page 6-40.
2. Close this ticket and attempt to reestablish the control path by pulling the drive sled out of the library, waiting for the Robot to scan the drive location, then reinserting the drive sled and securing the thumbscrews.
3. Wait for the drive to initialize and become ready
4. If this ticket reoccurs, continue to step 4 to switch the control path, otherwise, the problem is resolved and no further action is required.
5. Use the functions under the **Setup** > **Control Path** menu to switch the control path.
6. Whether you change the control path or not, you may Close this problem.
7. Any associated drive problem must be resolved separately.

DR033: Resolve Drive Sled Auto-Level Failure

Problem:

The library has attempted to change the firmware level in a drive sled but the process failed.

Troubleshooting Steps:

1. Using the drive coordinate from the problem Details, identify the drive sled that failed.
2. After you have located the drive on the rear of the library, unscrew the thumbscrews and pull the drive out of the library completely for at least 30 seconds. Re-insert the drive and tighten the thumbscrews.
3. Close the ticket, reinsert the drive sled, and tighten the thumbscrews.
4. The library should now attempt to discover and initialize the drive again.
5. If this second attempt to establish the drive firmware level fails, contact IBM Technical Support .

DR034: Resolve Open Storage I/O Door

Problem:

This library has an I/O station door that is configured to function as tape storage. This door was detected to be open at a time when the library needed it to be closed. The library cannot access these tape storage locations until this I/O door is closed and locked by the library.

Troubleshooting Steps:

There are two scenarios:

1. An I/O station door is genuinely open. If any I/O station doors are open, close them. Once the I/O station doors are closed, the library will automatically lock doors that are designated as storage. Close this operator intervention and monitor for reoccurrence.
2. There is a hardware failure that makes it appear that an I/O station door is open. If all doors already appear to be closed, use the I/O station test under **Tools** > **Service** > **System** > **Library** to test the function of the I/O station.

DR035: Resolve Robot Power Interruption

Problem:

The robot has momentarily pulled too much current. Circuit protection has occurred and a fuse may have blown or an internal power supply may have temporarily shut off.

Troubleshooting Steps:

1. Close this RAS ticket.
2. Open a library main access door, wait 10 seconds, and then close the main access door.
3. Observe library initialization.
4. If the robot does not initialize and/or a RAS ticket is displayed again, contact Service for further assistance.
5. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR036: Resolve Partially Open I/O Station

Problem:

An I/O station cannot be accessed.

Possible Causes:

1. The I/O Station safety flap may be broken
2. The I/O Station flap may be partially open. If so, please close it.
3. The control cable to the I/O Station is unplugged.
4. There is a hardware failure that makes it appear that an I/O Station door is partially open.

Troubleshooting Steps:

1. If any of the I/O Station safety flaps are broken, replace them.
2. If any of the I/O Station flaps are partially open, close them.
3. If none of the flaps are partially open, open the access door and look for the unplugged cable on the back of the lock assembly.
4. If none of the flaps appear partially open and cables are connected, use the I/O Station test under the **Tools** > **Service** > **Library** menu to test the function of the I/O Station.

DR037: Resolve Media Eject

Problem:

A drive has reported a problem that requires the currently loaded tape to be ejected from the drive in order for the drive to recover. Using the drive coordinate from the problem Details, identify the drive sled.

Possible Causes:

1. The I/O Station safety door may be broken
2. The I/O Station door may be partially open. If so, please close it.
3. The control cable to the I/O Station is unplugged.
4. There is a hardware failure that makes it appear that an I/O Station door is partially open.

Troubleshooting Steps:

1. Eject the tape from the drive and remove it out of the library.
2. Inspect the tape and retire the tape if problems are found:
3.
   - damaged cartridge shell
   - misplaced barcode labels or foreign material
   - snapped tape/disconnected leader
4. If the tape appears good, retry operations with the tape.

DR039: Resolve Logical Library Deletion

Problem:

The system has detected a change in module configuration such as a new control module serial number or a removed expansion module that will invalidate any existing logical library(s). Although a logical library may be visible on the user interface, the assignment of storage slots and drives is broken due to the new module configuration.

Troubleshooting Steps:

1. Using the Operator Panel, navigate to **Setup** > **Logical Library** and delete any existing logical libraries.
2. Consult the *Setup and Operator Guide* for information on how to create new logical libraries.

DR040: Resolve Incompatible Module Branding

Problem:

The library has detected a branding mismatch. This is most likely caused by a manufacturing labeling error or a user mixing incompatible parts from multiple library systems.

Troubleshooting Steps:

1. If this problem was reported following a field upgrade, or the replacement of a defective part, it is likely that the new part is not correct or mislabeled. Refer to “DR021: Contact IBM Service” on page 5-68.
2. If this problem occurred following the swapping of chassis, control boards, or compact flash cards between libraries, the two libraries have incompatible parts and the parts should be returned to their original libraries.
3. If neither of these scenarios apply or the problem remains unresolved, refer to “DR021: Contact IBM Service” on page 5-68.
4. **Close** the ticket or **Exit** to leave the ticket open for future troubleshooting.

DR041: Resolve Robot Installation

Problem:

The library has detected a condition that indicates the robot assembly has been installed incorrectly. The Robot travels on rack gears, Y-rails, located at the front and rear of the library. If the Robot is installed into the rack gears with one end higher or lower than the other, the robot assembly may not function properly.

Troubleshooting Steps:

1. The installation of the robot assembly should be performed again to correct the problem. Close the ticket and power off the library.
2. Reference the user documentation for removing and installing the robot's Y- carriage assembly.
3. Remove the robot assembly from the library.
4. Make sure the Y-rails are secured properly and verify that the left-side Y-rail columns are fully settled to the lowest positions.
5. Verify the robot parking tab is in the unparked position and not interfering with the robot Y-axis travel.
6. Install the robot assembly and assure that it is moving horizontally level along the Y-rails.
7. Power up the library and monitor for reoccurrence of the ticket.
8. If the ticket is not displayed again, the problem has been corrected.
9. If the ticket is displayed again, the problem still exists, requiring further inspection of the Y-rail and Y-carriage assembly motion.
10. Choose one of the following options:
    - Select **Close** to close the ticket now.
    - Select **Exit** to leave the ticket open for future troubleshooting.
    - Select **Back** to return to the Diagnostic Resolution.

DR042: Resolve Missing Cleaning Cartridge

Problem:

While performing inventory, the library determined that a cleaning cartridge is missing.

This cleaning cartridge was originally inserted via the library operator interface specifically for the library to use for cleaning tape drives. This cartridge is not managed by any host applications.

It is likely that this cartridge was manually removed while the library was powered OFF or when the main access door was opened.

Troubleshooting Steps:

1. You can determine the bar code label of the missing cleaning cartridge and the coordinate where it used to be stored by selecting the **Details** button.
2. A valid cleaning cartridge should be inserted into the library to allow cleaning operations to function properly.
3. If inspection of the cartridge slot shows the cartridge to be present, the bar code label is not being read reliably by the library. Replace the bar code label or the cartridge.

DR043: Resolve Invalid Cleaning Cartridge

Problem:

While performing inventory, the library determined that an invalid cartridge is occupying a cleaning slot.

In order for a cartridge to be a valid cleaning cartridge, it must be imported as a cleaning cartridge via the library operator interface.

It is likely that this invalid cartridge was manually inserted while the library was powered OFF or when the main access door was opened.

Troubleshooting Steps:

1. You can determine the bar code label of the invalid cleaning cartridge and the coordinate where it is located by selecting the **Details** button.
2. Open the library main access door(s) and remove this cartridge.
3. A valid cleaning cartridge should be imported into the library to allow cleaning operations to function properly.

DR044: Resolve Drive TapeAlert 4 - Media Error

Problem:

The tape cartridge is suspected due to failing tape operations. Data may be at risk based on the condition of the tape.

This problem may be caused by:

- the specific tape
- the specific drive
- the interaction of the tape and drive

Troubleshooting Steps:

1. Determine the specific cartridge and drive involved in the problem selecting the **Details** button.
2. Retry the operation with the same cartridge in the same drive.
3. If the retry attempt fails, copy data to a new cartridge.
4. Restart the current operation using a different cartridge.
5. If the problem remains unresolved, contact Service.

DR045: Resolve Drive TapeAlert 5, 6 - Read/Write Failure

Problem:

A drive has detected a problem reading from or writing to a tape.

This problem may be caused by:

- the specific tape
- the specific drive
- the interaction of the tape and drive

Troubleshooting Steps:

1. Determine the specific cartridge and drive involved in the problem selecting the **Details** button.
2. Retry the operation with the same cartridge in the same drive.
3. If the retry attempt fails, try the operation to the same cartridge in a different drive.
4. If the cartridge fails in more than one drive, retire the cartridge.
5. It the cartridge tests OK, use a known good cartridge to test the drive by performing read/write operations from a host, or by using a drive-specific utility. Contact Service for information on a drive utility for your specific drive type.
6. If the problem persists, gather a drive log afer the next occurrence of a Table Alert 5 or 6. Drive logs are captured by using the **Service Library** > **Capture Drive log** menu selection from the Web User Interface. Contact Service and provide the drive log.

DR046: Resolve Drive TapeAlert 8 - Suspect Data Grade Tape

Problem:

A drive has determined that a tape is not data grade and therefore data should not be written to it.

There can be several possible causes of this problem. Not all of the causes are genuine bad tapes, but in some cases a cartridge should be retired.

Troubleshooting Steps:

1. Attempting invalid operations with a cleaning cartridge may cause this problem. If the cartridge is a cleaning cartridge, remove it from the host application inventory of valid data cartridges.
2. If the cartridge is new, the tape may not have been formatted by the cartridge manufacturer. The drive will automatically attempt to format the tape. If successful, all other operations to the tape will continue without incident and this problem can be closed.
3. On LTO cartridges, the cartridge memory chip may be corrupted. Using host application utilities, force a read of the entire tape. When the tape is unloaded, the drive should repair the memory chip corruption. Monitor this cartridge for reoccurrence of a Tape Alert 8. Retire this cartridge if the problem occurs again.

DR047: Resolve Drive TapeAlert 15 - Cartridge Memory Failure

Problem:

A drive has determined that a memory in cassette (MIC) has failed. This will reduce performance. The cartridge memory may be repairable.

Troubleshooting Steps:

1. Attempt to repair the cartridge memory by using host backup application utilities to read the entire tape. When th tape is unloaded, the cartridge may be able to repair the tape memory.
2. To verify that the cartridge memory is repaired, attempt to use the cartridge again for normal read/write operations. If this cartridge fails again, retire the cartridge.

DR048: Resolve Drive TapeAlert 16 - Forced Eject

Problem:

A cartridge was manually ejected from a drive while it was actively reading or writing. This typically occurs when a user is servicing the drive and has not stopped all host operations to the drive.

Troubleshooting Steps:

1. Reload the tape cartridge back into the drive.
2. Restart the failed host application.

DR049: Resolve Drive TapeAlert 30, 31 - Drive Hardware Error

Problem:

The tape drive has detected an internal hardware error that requires a power cycle of the drive to recover.

Troubleshooting Steps:

1. Stop all additional host operations to this drive.
2. If a cartridge is still mounted in the drive, unload it using the host application or library operator interface.
3. Using the local library operator interface, take the drive offline with the **Operations** > **Change Drive Mode** command (on the web client, the path is **Operations** > **Drive** > **Change Mode**).
4. Once the drive is offline, the blue LED on the rear of the drive should be turned ON solid blue. At this point, remove the drive completely from the library for at least 1 minute.
5. Re-install the drive and wait for the normal drive LED states to be established:
   - green blink once per second
   - amber OFF
   - blue ON solid (drive is offline)
6. Using the local library operator interface, take the drive online with the **Operations** > **Change Drive Mode** command (on the web client, the path is **Operations** > **Drive** > **Change Mode**).
7. Attempt host operations again. If the drive fails immediately or the problem becomes chronic, contact Service.

DR050: Resolve Invalid Tape Location

Problem:

While performing inventory, the library determined that a cartridge is located in an invalid location. In early level libraries that are 23U or taller, the top slot in each of storage columns 4 and 5 can not be accessed by the robot and therefore can not be used for cartridge storage. It is likely that this cartridge was placed into the slot manually by a user. The library will not place cartridges into these slots based on host or user commands.

Troubleshooting Steps:

1. Select the Details button to determine the barcode label of the cartridge and the coordinate where it is located.
2. Open the main access door(s) and remove this cartridge. Columns 4 and 5 are on the right side of the library as you face it.
3. Close the door(s) and resume operations.

DR051: Resolve Library SN Label Detection

Problem:

The library can not read one of the module serial number labels but has already validated that the bar code scanning system is working properly.

Troubleshooting Steps:

1. Open the main library doors, and look for any obstructions in front of the module serial number bar code labels.
2. If no obvious foreign material is found, the module SN is damaged and the EM or CM will need to be replaced. The library is still operational but this should be scheduled as soon as possible.
3. Contact Service for possible CM or EM replacement.

DR053: Resolve Network Configuration Issue

Problem:

The library has attempted to send an email to the specified address, but has encountered an error with the network configuration.

Troubleshooting Steps:

1. Check the email and mail server settings on the library to ensure that all values are correct.
2. Check to make sure the library is properly connected to the network.
3. Make sure the network cable is not damaged.
4. If there is no problem with these items, there is a configuration problem with your network. Contact your network administrator for assistance troubleshooting this issue.

DR054: Resolve Open Drive Bay

Problem:

The library has detected that a drive bay has been opened in the rear of the library, and a cover plate has not been installed. For safety reasons, the robot will run at a slower speed until a drive sled or a drive cover plate is installed.

Troubleshooting Steps:

1. If the cover removal was intentional, reinstall the cover plate to resolve this issue. The robot will again move at full speed.
2. If a drive sled or drive bay cover plate removal was not intentional, check the back of the library for any unsecured drive sleds and loose, missing, or damaged drive bay cover plates.
3. Secure all drive sleds and drive cover plates. Contact Service if any drive cover plates are damaged or missing, or drive sleds or cover plates cannot be secured.

DR055: Resolve Installation & Verification Test Error

Problem:

A problem was detected while performing system validation testing.

<Description added at runtime>.

Check the IVT logs for further details.

Troubleshooting Steps:

<Description added at runtime>.

1. Close the ticket now.
2. Exit to leave it open for further troubleshooting.
3. Return to the Diagnostic Resolution now.

DR056: Resolve Module Communication

Problem:

The library has encountered an error when trying to initialize its modules.

Troubleshooting Steps:

1. Turn the library OFF.
2. Remove both the top and bottom terminators and carefully inspect them for bent pins. If any are found, contact Service for replacement.
3. Remove all module-to-module connectors and carefully inspect them for bent pins. If any are found, contact Service for replacement.
4. If no bent pins are found on any of these parts, contact Service for further assistance.

DR068: Resolve Incompatible Tape Drive

Problem:

The drive that is installed is not compatible with the library.

Troubleshooting Steps:

1. View the ticket details to see which drive is not compatible and remove that drive from the library.
2. Replace the drive cover plate.
3. Contact Service for assistance with resolving this issue.

DR069: Resolve Drive Firmware Update Failure

Problem:

An attempt to update the firmware of a drive was not successful.

Troubleshooting Steps:

1. Verify that the version being used for the upgrade is different from what the drive is currently using. If not, close this ticket and retry the upgrade with the correct firmware version.
2. If the upgrade is being performed via a firmware upgrade cartridge, ensure that the cartridge contains the correct firmware for the type and generation of the drive being updated. Also, check that the firmware upgrade cartridge is not corrupted. If so, close the ticket and upgrade again with the correct firmware upgrade cartridge.
3. If the update was not performed with a firmware upgrade cartridge, ensure that the file containing the firmware image is not corrupt or incomplete. If so, close the ticket and upgrade again with the correct firmware upgrade file.
4. If none of these conditions apply, close this ticket and attempt the upgrade a second time.
5. If this ticket reappears after retrying the upgrade, contact Service for assistance with resolving this issue.

DR070: Resolve Tape Drive Firmware Mismatch

Problem:

The library has detected that all drives do not have the same firmware version.

Troubleshooting Steps:

1. Go to the **Tools** > **Drive Info** screen on the local control panel, or **Service Library** > **Update Drive Firmware** on the Web User Interface to view the firmware version installed on each drive.
2. Note the drive(s) that do not have the latest version of firmware and upgrade those drives. See "Updating Drive Firmware" on page 6-27.

DR072: Resolve Tape Drive Auto-level Failure

Problem:

The automatic update of drive brick firmware failed. The code image stored on the library appears to be invalid.

Troubleshooting Steps:

1. Download a new drive brick firmware image through the Web UI.
2. Close this ticket and reboot the library so that the drive brick upgrade is performed again upon initialization.
3. If this ticket reappears, contact Service for further assistance.

DR074: Resolve Unassigned Inaccessible Tape Cartridge

Problem:

At least one cartridge has been detected in a slot that is not assigned to any logical library and is therefore not accessible by the library or by any host application.

Troubleshooting Steps:

1. Go to the **Monitor System** > **Library Map** screen in the Web User Interface to view the logical library map.
2. Open the main library door and look for cartridges in slots that are not included in any logical library per the Library Map.
3. Manually remove any of these cartridges and, if desired, insert them back into the library.

DR075: Resolve Installation & Verification Test Warning

Problem:

The Installation & Verification Test returned a result indicating that one of the tests was not successful. The library is still functional and can be used normally, however this may be an indication of a developing problem.

Troubleshooting Steps:

1. Review the ticket details and the Installation & Verification Test logs to determine which library component failed.
2. Check if any new RAS tickets have been generated against the failed component. If so, contact Service for further assistance in resolving this issue.
3. Monitor the library for any further problems with this component. If no further RAS tickets are generated, the library can continue to be used normally.

DR076: Resolve Get Failure

Problem:

The library robot has failed during a move media, while trying to get a tape. Operations can continue, but the tape should be manually removed.

Troubleshooting Steps:

1. Open the library main door and inspect the picker for damaged fingers or any other obstruction. If found, remove the obstruction or contact Service for picker replacement.
2. View the ticket details for the tape location. Inspect the tape and slot for any damage that may cause the tape to get stuck in the slot. If the tape is damaged, replace the tape with a good one. If the slot is somehow damaged, contact Service for replacement.
3. If the tape is in a drive, inspect the drive for any damage that would prevent tape ejection. If found, replace the drive.

DR077: Resolve Invalid Cleaning Tape

Problem:

The system has detected that a non-cleaning tape was used to clean a drive.

Troubleshooting Steps:

1. Using the barcode listed in the ticket details, locate the tape in the library.
2. If the cartridge is configured for automatic library initiated cleaning operations, consult your user guide to export a cleaning tape from the library and import a valid cleaning cartridge for future use.
3. If the cleaning tape was configured for application use, consult your user's guide to export the tape cartridge and import a valid cleaning tape for future use.
4. If a manual drive cleaning was performed, replace the tape cartridge with a valid cleaning tape and repeat the drive cleaning operation.

DR078: Resolve Tape Load/Unload Failure

Problem:

A tape drive did not load a tape correctly. Library automatic recovery was not successful and user intervention is required.

Troubleshooting Steps:

1. Attempt to unload the tape from the drive using the host backup application that is currently using the drive, or via the remote or local UI.
2. Open the library main access doors and use the blue pushbutton on the front of the drive to trigger an unload. Press and hold the button continuously for 10 seconds.
3. If the tape is ejected, retrieve it and inspect it for any damage. If found, discontinue use of the tape.
4. If the tape is not ejected, contact Service for further assistance in resolving this issue.

DR079: Resolve Key Server Communication Issue

Problem:

The library is not able to communicate with a Key Server. This does not indicate a problem with the library, but rather a configuration or setup issue.

Troubleshooting Steps:

1. Ensure that the library is properly connected to the network, and that the network cable is not damaged.
2. Ensure that the library's Library Managed Encryption settings are correct. Ensure the settings contain the correct key server IP address and port number.
3. Verify that the Key Server is powered ON, operational, and that it is also properly connected to the network.
4. Ensure that the key server's IP configuration is set properly, that the ports are configured correctly, and that they are active. Ensure the Key Manager is running on the key server.
5. Run the **Service Library** > **Key Path Diagnostics** to assist in isolating the problem. This diagnostic consists of four tests:
   a. Drive Test - This is a drive communication test to ensure that the Library-Drive Interface (LDI) is functioning properly.
   b. Ethernet Test - This is a key server 'ping' test of all IP addresses associated with LME configured drives.
   c. EKM Path Test - This is a communication test used to establish a link to a key manager and ensure that the communication paths between each drive and the EKM have been correctly installed and set up.
   d. EKM Config Test - This is a final test to establish a link to a key manager and request a default key. This ensures that the drive has been correctly configured in the EKM to service key requests
6. If there is no problem with any of these items, there is a configuration problem with your network. Contact your network administrator for assistance with troubleshooting this issue.

DR080: Resolve Unreadable Branding

Problem:

The library cannot read the module branding identifier but has already validated that the bar code scanning system is working properly.

There are two likely scenarios:

1. Line of sight from the scanner to the module branding label is blocked by foreign material such as a media bar code label.
2. The module branding label is damaged and the bar code scanner cannot read it reliably.

Troubleshooting Steps:

1. Open the CM main library door. Look for any obstructions in front of the module branding bar code labels.
2. If no obvious foreign material is found, the module branding label is damaged and the CM will need to be replaced.

DR081: Resolve Autoclean Failure

Problem:

The library's AutoClean feature encountered an error and did not clean a drive.

Troubleshooting Steps:

1. View the Monitor System->Library Map report to locate the configured cleaning slots.
2. Open the main library door and inspect these cleaning slots. Verify that all the tapes occupying the cleaning slots are valid cleaning tapes, particularly the tape with the volser mentioned in the ticket details.
3. This issue may have been caused by an error elsewhere in the library. Check for and resolve other unopened RAS tickets.

DR082: Resolve Library Calibration Failure

Problem:

The library encountered a problem during calibration. This ticket can be caused by a blocked or obscured line of sight of the calibration sensor or a damaged white calibration target. This ticket can also be caused by a brightly colored tape cartridge located in a slot immediately above a white I/O station calibration target.

Troubleshooting Steps:

1. Note the ticket details to determine the library module as well as any I/O or storage column, or drive location; then close the ticket.
2. If the ticket details identified an I/O station column of a module, perform the following steps:
   a. Ensure the I/O station in the identified module was firmly closed to allow proper calibration.
   b. If it was properly closed, open the I/O station and inspect the white I/O station calibration target for any damage, such as scratches in the white calibration target square.
   c. If no damage is found, inspect the slot above the I/O station calibration target for a brightly colored tape cartridge (yellow or orange). If such brightly colored tape cartridge is present, ignore this ticket and continue.
3. If the ticket details identified a storage location, perform the following steps:
   a. Open the access door identified in the ticket details and locate all white calibration targets of the identified storage column and inspect them for any damage.
   b. If no damage is found, open the bottom main access door of the module and gently move the picker assembly towards the door opening. Then rotate it gently as far clockwise as possible.
   c. Open and fully extend the bottom I/O station door, then reach through the main access door. Locate the picker assembly recessed calibration sensor in the picker base, slightly to the right of the center line. Gently wipe the surface of the calibration sensor with a soft, lint-free cloth.
4. If the ticket details identify a drive sled, remove the identified drive and inspect the calibration bracket horizontal white stripe for any damage.

Note: This graphic shows the location of the calibration sensor. If you are guiding a customer by phone, you might want to copy the graphic and email it to them.

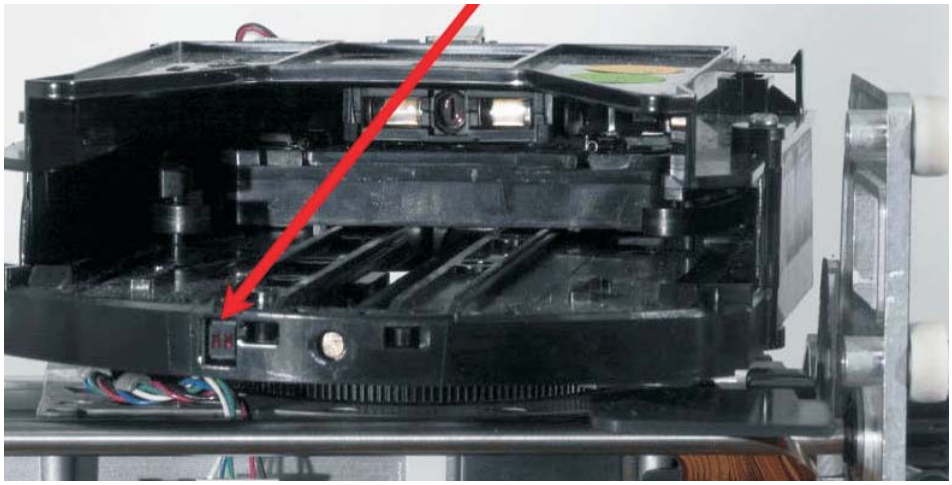

Figure 5-2. Calibration sensor

DR083: Resolve Drive Voltage Problem

Problem:

A tape drive detected a voltage problem. This problem may occur when a separate drive is being activated.

Troubleshooting Steps:

1. Close this ticket, then remove and reinsert the drive sled to clear the fault.
2. If this ticket reoccurs, ensure that the facility AC power cable is secured to the power supplies. Ensure that no fault condition is indicated on the power supply LEDs.

DR084: Resolve Robotics Firmware Image Error

Problem:

The normal robotics firmware auto-level process was not attempted. This problem is caused by a missing or corrupt robotics firmware update file.

Troubleshooting Steps:

1. Close this ticket, then perform a library firmware upgrade to the current firmware revision.

DR085: Resolve Robotics Auto-Level Failure

Problem:

The normal robotics firmware auto-level process did not complete successfully. This problem may be caused by one of the following conditions:

1. A robotics flash image failed validation by the Y-Axis/Picker Assembly Controller Board.
2. A flash programming error occurred on the Y-Axis/Picker Assembly Controller Board.
3. An error occurred when updating the picker Imager flash.

Troubleshooting Steps:

1. View the ticket details and note which firmware image failed.
2. Close this ticket.
3. Retry the auto-level process by re-initializing the robot (i.e., open and close the main access door).
4. If this ticket reoccurs during the retry, continue to Step 5. Otherwise, no further action is required.
5. If 'Robot' firmware is identified in Step 1, replaceY-Axis Picker/Assembly Controller Board. If 'Imager' firmware is identified in Step 1, replace the Picker assembly.
6. Close this ticket, then perform a library firmware upgrade to the current firmware revision.

DR086: Resolve Robotics Degraded Flash Warning

Problem: One of the Y-Axis/Picker Assembly's flash partitions could not be updated. Because one of the two flash partitions is properly functioning, auto-level can still occur and the robotics subsystem can go ready. This is a Warning ticket. Flash is in a degraded mode and the backup image is unavailable.

Troubleshooting Steps:

1. Replace the Y-Axis/Picker Assembly Controller Board.
2. Close this ticket and monitor for recurrence.

DR088: Resolve Robotics Y-Axis Motion Failure

Problem: The library robot has failed to perform a motion in the y-axis. The detected failure is likely to be a genuine hardware failure.

Troubleshooting Steps:

1. Open the main access door(s) and look for any obvious problems such as damage to the robot assembly, or tape cartridges and debris that may have collected on the floor of the library.
2. Reposition any tape cartridges found extending from storage locations.
3. Remove any tape cartridges found in the picker assembly.
4. Inspect any recovered tape cartridges for damage.
5. Close the doors and wait for the system to complete initialization. Use the Tools>Service>Library>Robot test to determine if the failure is permanent.
6. If the test fails, replace the Y-Axis/Picker Assembly.
7. If the test passes, continue to close this Ticket.
8. Make sure the logical libraries are online and continue normal library operations. Monitor for recurrence of the problem.

DR089: Resolve X, Z, Theta Axis Motion Failure

Problem: The library robot has failed to perform a motion in the x, z or theta axis. The detected failure is likely to be a genuine hardware failure.

Troubleshooting Steps:

1. Open the main access door(s) and look for any obvious problems such as damage to the robot assembly, or tape cartridges and debris that may have collected on the floor of the library.
2. Reposition any tape cartridges found extending from storage locations.
3. Remove any tape cartridges found in the picker assembly.
4. Inspect any recovered tape cartridges for damage.
5. Close the doors and wait for the system to complete initialization. Use the Tools>Service>Library>Robot test to determine if the failure is permanent.
6. If the test fails, replace the Y-Axis/Picker Assembly.
7. If the test passes, continue to close this Ticket.
8. Make sure the logical libraries are online and continue normal library operations. Monitor for recurrence of the problem.

DR090: Resolve Robotics Hardware Error - RCB

Problem: Robotics firmware has reported a specific hardware error identifying the Robot Controller Board as the failed component. This problem may be caused by an electrical hardware failure.

Troubleshooting Steps:

1. Close this ticket and reinitialize the Robot by opening and closing the Main Access Door(s).
2. If this ticket reoccurs after the Robot reinitializes, replace the Y-Axis/Picker Assembly.

DR091: Resolve Robotics Hardware Error - Picker

Problem: The robotics firmware has reported a specific hardware error identifying the Picker assembly as the failed component. This problem may be caused by an electrical hardware failure at the Picker assembly or at the Robot Controller Board.

Troubleshooting Steps:

1. Close this ticket and reinitialize the Robot by opening and closing the Main Access Door(s).
2. If this ticket reoccurs after the Robot reinitializes, replace the Picker Assembly.

DR092: Resolve Robotics Hardware Error - Scanner

Problem: The robotics firmware has reported a specific hardware error identifying the robot scanner as the failed component. This problem may be caused by one or more of the following conditions.

1. An obstruction in the viewing path of the robot scanner.
2. Electrical hardware failure at the Picker assembly or at the Robot Controller Board.

Troubleshooting Steps:

1. Open the main access door(s) and check for any obvious obstruction blocking the view of the robot scanner.
2. Close this ticket and reinitialize the Robot by opening and closing the Main Access Door(s).
3. If this ticket reoccurs after the Robot reinitializes, replace the robot controller board or Picker Assembly.

DR093: Resolve Robotics Communication Error

Problem: The library firmware has detected a communication failure with the robotics subsystem. This problem may be caused by one or more of the following conditions:

1. Power loss to the robot assembly.
2. Y-Axis Cable Spool or connection failure.
3. Electrical hardware failure.

Troubleshooting Steps:

1. Ensure that the main access door(s) are closed.
2. Ensure that all module terminators and Box to Box cables are properly connected.
3. Determine the robot location within the system, then open the I/O station closest to the robot position to determine whether the green LED on top of the picker is on.
4. If the picker LED is not on, open the main access door(s) and verify that the Y-Axis Cable Spool is properly attached and not damaged.
5. Close this ticket and reinitialize the Robot by opening and closing the Main Access Door(s).

DR094: Resolve Incompatible Robot Installed

Problem:

The library firmware has detected that an incompatible robot has been installed. This problem occurs when a robot assembly has been replaced with an incorrect type.

Troubleshooting Steps:

1. Replace the installed robot assembly with the required, originally installed, robot assembly model type.
2. Call Service for complete robot assembly replacement including:
   - Robot Controller Board
   - Y- carriage Assembly
   - Picker Assembly

DR095: Resolve Drive Sled Auto-level Failure

Problem:

The library is not able to auto-level any of the drive sleds. This problem may be caused by a missing or corrupt firmware update image file.

Troubleshooting Steps:

1. Close this ticket and perform a library firmware upgrade to the current production firmware revision.

DR096: Resolve Drive Cleaning Failure

Problem:

After the drive was cleaned and the cleaning tape was removed from the drive, the drive continues to request drive cleaning. This could indicate a problem with the drive.

Troubleshooting Steps:

1. Close this ticket and perform a manual drive cleaning with a different cleaning tape.
2. If this ticket reoccurs following the manual cleaning, take the drive offline.

DR098: Resolve Hardware Clock Failure

Problem:

The library firmware detected that the hardware clock (RTC) has failed. The library system time may appear to be set correctly, but accurate time will be lost following a power cycle or reboot.

Troubleshooting Steps:

1. The hardware clock (RTC) is part of the LCB hardware. Replace the LCB.

DR099: Resolve Barcode Label Mapping

Problem:

There was a barcode scanning error detected during an attempt to inventory the library. There are two possible scenarios:

1. Improper application of barcode label(s).
2. Magazine(s) improperly seated.

Troubleshooting Steps:

1. Verify that all library and tape barcode labels are properly attached and that no overlapping barcode labels are visible.
2. Ensure that all magazines are properly installed and that all barcode labels are visible.
3. Open and then close the access door in order to cause the library to perform another inventory.

DR100: Resolve Barcode Scanner Malfunction

Problem:

The bar code scanner is communicating properly but cannot read any bar codes. There are two likely scenarios:

1. Line of sight from the scanner to the module branding label is blocked by foreign material such as a media bar code label.
2. The bar code scanner is damaged and the Y-Axis/Picker Assembly needs to be replaced.

1)

Troubleshooting Steps:

1. Open the library door to gain access to the robot. Look for any obstructions in front of the bar code scanner (inside the mouth of the picker).
2. If no foreign material is found, the bar code scanner is damaged and the Y-Axis/Picker Assembly will need to be replaced.

DR101: Resolve Tape Drive Type Change

Problem:

The library firmware detected that a tape drive assigned to a partition has been replaced with a tape drive of a different type. A tape drive's type is defined by its vendor, generation, and interface. Perform one of the following options to activate the new tape drive.

Troubleshooting Steps:

- Replace the new tape drive with one that is of the exact type as the original tape drive.

OR

- Remove the original tape drive from the partition's configuration, then add the new tape drive to the partition's configuration. To do this, follow these steps:
  1. From the Main Menu, select **Manage Library** > **Logical Libraries**.
  2. From the Logical Libraries menu, select the partition to be modified. Select 'Modify' from the drop down selection list, then select the 'Go' button.
  3. From the Modify Logical Library menu, click on the 'Select Drives to Assign to Logical library' link. Deselect the original tape drive from the drives list and select 'Apply'.
  4. From the Modify Logical Library menu, click on the 'Select Drives to Assign to Logical library' link. Select the new tape drive from the drives list and select 'Apply'.

DR102: Resolve Robotics Z Axis Motion Failure

Problem:

The library Y-Axis/Picker Assembly has failed to perform a motion in the z-axis. The detected failure is likely to be a genuine hardware failure.

Troubleshooting Steps:

1. Open the Main Access Door(s) and look for any obvious problems such as unplugged cables or damage to the picker.
2. Remove any tape cartridges from the picker or the path of Y-Axis/Picker Assembly motion. Close the doors and wait for the system to complete initialization.
3. Use the **Tools** > **Service** > **Library** > **Robot** test to determine if the failure is permanent.
4. If the test fails, replace the Y-Axis/Picker Assembly.

DR103: Resolve Display Assembly Communication Failure

Problem:

A problem has been detected and isolated to a communication link failure to the library's local display assembly. The nature of the problem indicates that replacement of the display assembly may be required. Your library should remain operational from the remote browser interface.

Troubleshooting Steps:

1. If this ticket and T064 - LCB Hardware Failure are generated within a few minutes of each other, the problem lies with one of the power supplies in the CM. Replace the Power Supply.
2. Examine all cabling at the back of the display assembly and within the CM for proper connectivity. Inspect for damage.
3. If no cabling problems are found, and no concurrent tickets have been posted against the LCB, replace the display assembly.

DR105: HPF Connection Failure

Problem:

A Fibre Channel I/O blade has detected that its secondary host port failover (HPF) port connection has failed.

Troubleshooting Steps:

1. Note the Fibre Channel I/O blade location and identify the Fibre Channel cable connection.
2. Ensure that the Fibre cables are properly connected to both the switch and the Fibre Channel I/O blade and that the cable connections are undamaged and free of debris.
3. Reset the port on the Fibre Channel I/O blade via the local or remote user interface.
4. If the problem persists, contact Service for further assistance.
5. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR106 - Resolve Media Security Notification

Problem	The library has been configured to inform of unexpected cartridge removal, expected tape cartridge removal or both: • Media removal is expected whenever an exported cartridge has been physically removed by an operator from an I/O area element. • Media removal is not expected if a cartridge was previously detected in a storage, drive, or I/O element without having been exported or moved by the robot to a respective I/E area element for operator access and removal.

Troubleshooting Steps	• If the media removal was expected, I/O area elements might be available for operator initiated cartridge insert operations, import operations or both. • If the media removal was unexpected, cartridge removal authorization might need to be validated. 1. To view which cartridges have been removed, go to **Service Library** > **Media Security Log** and select **Media Security Log**. 2. You have three options: • Select **Close** to close the operator intervention. • Select **Exit** to leave the operator intervention open for future troubleshooting. • Select **Back** to return to the Diagnostic Resolution.

DR110: Resolve Drive Encryption Control Failure

Problem:

A tape drive reported that the requested drive encryption method could not be enabled.

Troubleshooting Steps:

1. Note the drive sled coordinate from the RAS ticket and close the ticket.
2. Make sure the referenced tape drive is not loaded with a tape cartridge. Unload the drive if a tape cartridge is present.
3. Verify that the tape drive firmware version is at least at the firmware version referenced in the release notes for the currently installed library firmware version. Update the tape drive firmware if a newer version is required.
4. Consult your user documentation regarding removal and replacement of a drive sled.
5. Remove the drive sled identified in the RAS ticket, wait for 1 minute and then re-insert and secure the same drive sled into its drive bay location.
6. Wait for the drive to initialize and become ready.
7. Make sure the logical library partition is configured for the correct encryption method and no RAS ticket is generated against the drive.
8. From the remote user interface, view the library configuration by selecting **Reports** > **Library Configuration**.
9. Click on the respective drive coordinate and verify the drive encryption method setting.
10. Contact Service if an issue remains.
11. Choose one of the following options:
    - Select **Close** to close the ticket now.
    - Select **Exit** to leave the ticket open for future troubleshooting.
    - Select **Back** to return to the Diagnostic Resolution.

DR111: Resolve Drive Encryption Service Request Monitoring

Problem:

A tape drive reported that an encryption request needed to be serviced, but the drive did not indicate required encryption key request details. The drive sled controller suspended encryption key exchange request monitoring until the tape cartridge is unloaded.

Troubleshooting Steps:

1. Note the drive sled coordinate from the RAS ticket and close the ticket.
2. Unload the tape cartridge from the drive.
3. Reload the tape cartridge and restart the host application.
4. If the RAS ticket displays again, close the ticket and unload the drive.
5. Consult your user documentation to reset the drive.
6. Once the drive is operational again, reload the tape cartridge and restart the host application.
7. If the problem persists, contact Service for further assistance.
8. Choose one of the following options:
   - Select **Close** to close the ticket now.
   - Select **Exit** to leave the ticket open for future troubleshooting.
   - Select **Back** to return to the Diagnostic Resolution.

DR118 - Resolve EKM Path Diagnostic Delay

This diagnostic resolution provides customer resolution steps for "T149 - Key Path Diagnostic Delay" on page 5-58.

Problem	The library attempted to perform a Key Path Diagnostic via an available encryption-capable tape drive per the test interval setting. However, all configured tape drives are either loaded, unavailable, or otherwise busy, and cannot initiate the Key Path Diagnostic to determine proper EKM server connectivity and operability.
Troubleshooting Steps	1. View the operator intervention details to determine which EKM server cannot be tested because the drives are not available to initiate a Key Path Diagnostic. 2. Determine whether all tape drives that are configured for such EKM server access are currently mounted or otherwise unavailable and can therefore not initiate a Key Path Diagnostic. 3. If none of the configured tape drives are available to initiate a Key Path Diagnostic, ignore and close this operator intervention. If applicable, configure the testing interval time and/or warning threshold to a less frequent testing period to avoid drive access contention and operator intervention generation. 4. If a tape drive is available to initiate a test, consult your user documentation to initiate a Key Path Diagnostic: a. If the test succeeds, close this operator intervention and observe for further occurrences. b. If the test fails, analyze the issue and correct the problem or contact Service for further assistance. 5. You have three options: • Select **Close** to close the operator intervention. • Select **Exit** to leave the operator intervention open for future troubleshooting. • Select **Back** to return to the Diagnostic Resolution.

Chapter 6. Service Procedures

This chapter contains library diagnostic information.

"How the Library Reports Problems" on page 6-2
"Working with Operator Intervention Messages" on page 6-2
"General Service Guidelines" on page 6-3
"Possible Safety Hazards" on page 6-4
"Electrostatic Discharge" on page 6-4
"Service Menus" on page 6-5
"Using the Service Port" on page 6-9
"Methods of Capturing Logs" on page 6-11
"Emailing Logs" on page 6-13
"Saving/Restoring System Configuration" on page 6-13
"Key Path Diagnostics" on page 6-14
"Interpreting LEDs" on page 6-17
"Methods of Updating Firmware" on page 6-25
"Checking/Reseating Cables" on page 6-30
"Taking the Drives/Library Online/Offline" on page 6-39
"Resetting a Drive" on page 6-40
"Shutting Down/Restarting the Library" on page 6-40
"Manually Recover Cartridge from Picker" on page 6-41
"Manually Unlocking the I/O Station Door" on page 6-43
"Applying a RID Tag to a Library Module" on page 6-44
"Applying an Agency Label to a Control Module" on page 6-45
"End of Call" on page 6-47

This library can automatically detect host servers in the Storage Area Network (SAN) and perform periodic self-tests to ensure that the library is fully operational. If the library detects a problem, it isolates where the problem exists and provides helpful instructions for resolving the problem. It also supports geographic addressing, which means that you can install tape drives in any open drive slot, and the library will automatically update its configuration model without requiring you to assign the address of the drive yourself.

The control module houses the central intelligence of the library; without it, the library cannot function. The control module contains several essential components, including the library control blade and the robotic picker assembly. The library control blade controls the library's functions, while the robotic picker assembly is responsible for physically retrieving data cartridges from the library's storage slots, inserting the cartridges into the appropriate tape drive, and returning them to their appropriate storage slot. The control module also provides a configurable I/O

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Station for importing and exporting data cartridges, and several columns of fixed storage space. You can control the library using its LCD Operator Panel, or by using the remote Web User Interface.

An expansion module provides a configurable I/O Station and additional space for tape drives and fixed tape storage.

How the Library Reports Problems

This library uses advanced problem detection, reporting, and notification technology to alert customers of problems as soon as they occur. It performs numerous self-tests to monitor the library's temperature, voltage and currents, and standard library operations. These self-tests are performed each time the library is powered ON, and during normal operation when the library is idle.

If the self-test detects a problem, the library generates a service report, or Operator Intervention, that identifies which component is likely causing the problem. The library's LEDs may also turn ON, OFF, or blink to indicate an abnormal state. If the problem is not severe, the library continues to provide full functionality to all unaffected logical libraries.

When possible, the library provides instructions for resolving problems. These instructions appear on the library's Operator Panel.

Note: If resolution of the problems includes instructions to open an Access Door, an Access Door must be opened and closed to clear the error and to enable the robotics to function properly.

Customers can frequently resolve a simple problem themselves by using the information found in Chapter 1, "Start Service," on page 1-1. If the problem involves a field replaceable unit (FRU), the customer must contact IBM Technical Support . Only qualified service technicians can service FRUs.

Working with Operator Intervention Messages

From the **Tools** menu on the Operator Panel, you can view all of the library operator interventions. This view lists all of the library operator interventions in the order in which they were created starting with the most recent. Each message contains a Service Action Ticket (SAT) code (see "Service Action Tickets" on page 5-1) and an explanation of what error the library encountered. You can navigate resolution details from this screen as well (see "**Diagnostic Resolutions**" on page 5-59). Before replacing a library component, closing a ticket, or contacting IBM Technical Support, refer to Chapter 1, "Start Service," on page 1-1 for additional help on resolving the problem.

Important: It is recommended that Service Action Tickets not be allowed to accumulate in the Operator Intervention reports. After an incident has been resolved or repaired, the Service Action Ticket should be closed.

Before ordering a CRU replacement part, observe the LEDs on all library components to determine exactly which part is failing. See "Interpreting LEDs" on page 6-17 for more information.

Viewing Operator Intervention Messages

You can view operator intervention messages by choosing Operator Interventions from the Tools menu. You can also click the Subsystem Status

buttons at the bottom of the graphical user interface home page to view all operator interventions for the subsystem you choose (Library, Drives, or Media). Operator Intervention messages are displayed in the order in which they were created, starting with the most recent. Click a column heading to sort the rows by that heading.

Resolving Operator Intervention Messages

You can resolve and close operator intervention messages from the Tools - Operator Interventions screen. Identify the Operator intervention message that you want to resolve, click Resolve, and complete the steps listed in the Library Resolution window. It is possible to close the operator intervention message without ever resolving the reported issue.

Closing RAS Tickets Automatically

The library will close all currently open operator intervention messages when you reboot the library. If any errors occur during the reboot, the library issues new operator intervention messages. In order for automatic ticket closure to occur, a user must intentionally initiate a reboot, by either restarting the library, shutting down the library, or upgrading library firmware. Automatic ticket closure will NOT occur if the library shuts down unexpectedly or if the power cord is unplugged. You can always view closed tickets on the Web client by selecting Service Library > Operator Interventions and clicking on Closed State. Tickets that were auto-closed are designated as "Canceled." Automatic ticket closure is enabled by default. You can enable or disable this feature from the operator panel. The path to open the appropriate screen is: From the operator panel, select Tools > System Settings and then select or clear the Auto-Ticket Closure check box.

Closing All Operator Intervention Messages

You can close all operator intervention messages without resolving them by clicking the Close All Tickets button. Be extremely careful when doing this. It is recommended that each operator intervention be viewed, analyzed, and closed individually.

General Service Guidelines

Servicing a library typically includes the following steps:

1. Connect your laptop to the service port, located on the back of the Library Control Blade, in order to use the Web User Interface (UI) (see “Using the Service Port” on page 6-9).
2. Generate a log of the current status of the library (see “Methods of Capturing Logs” on page 6-11).
3. Assess the status of the library, using the following tools. Thoroughly examine all available reports and indicators.
   - Operator Interventions
   - LEDs
   - System diagnostics (which are available via the **Service** menu (see “Service Menus” on page 6-5) on the library's Operator Panel)
4. Create a list of parts that you need to add, remove, or replace, and determine the order in which you plan to service them.
5. Order any necessary parts. (See Chapter 9, “Parts List,” on page 9-1.)
6. Review the cabling connections for each module. If you need to disconnect the cables to remove or replace a field replaceable unit (FRU), consider labeling the cables so you can reconnect them correctly.

7. When you are ready to service the library, determine whether you will need to take the entire library offline or whether you can take only certain logical libraries offline. See “Required Library State” on page 7-2.
8. Contact the library administrator to schedule a time to take the library or logical library offline, if necessary. Before taking the library offline, ask the administrator to complete or cancel any jobs that are in the queue.
9. Power OFF the library or take it (or just the affected logical libraries) offline.
10. Add, remove, and replace each part, as necessary.
11. After servicing the library (and preferably after servicing each part), power ON the library and run the appropriate diagnostic. From the Operator Panel, select **Tools** > **Library Tests** to access the Library Verify Tests.
12. When you finish adding, removing, and replacing all necessary parts, verify that all drives are online, then take the library online (see “Taking the Drives/Library Online/Offline” on page 6-39).
13. Close all open Operator Interventions.
14. Verify that your host applications can communicate with all drives and the library.
15. After verifying that the library is fixed and running smoothly, generate another log of the status of the library.
16. Complete the steps in “End of Call” on page 6-47.

Possible Safety Hazards

Possible safety hazards to the operation of this product are:

Electrical
An electrically charged frame can cause serious electrical shock.

Mechanical
Hazards (for example, a safety cover missing) are potentially harmful to people.

Chemical
Do not use solvents, cleaners, or other chemicals not approved for use on this product.

Before using the library, repair any of the preceding problems.

Electrostatic Discharge

Important: A discharge of static electricity can damage static-sensitive devices or microcircuitry. Proper packaging and grounding techniques are necessary precautions to prevent damage.

To prevent electrostatic damage, observe the following precautions:

- Transport products in static-safe containers such as conductive tubes, bags, or boxes.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free stations.
- Cover the unit with approved static-dissipating material. If available, provide a ground strap connected to the work surface and properly grounded tools and equipment. If a ground strap is not available, touch a metal surface to discharge any static electricity in your body.

- Keep the work area free of non-conducting materials, such as ordinary plastic assembly aids and foam packing.
- Make sure you are always properly grounded when touching a static-sensitive component or assembly.
- Avoid touching pins, wires, or circuitry.
- Use conductive field service tools.

Service Menus

The **Service** login gives service personnel access to troubleshooting tools.

To access the service functions, log into the Operator Panel using your service name and password.

When logged into the Operator Panel as **Service**, there are 2 additional items available under the **Tools** menu. They are **Factory Defaults** and **Library Tests**.

Logging in with Service Privileges

To log in with service privileges:

1. Access the **Logon** window of the Operator Panel.
2. Type your service name (**service**) and password (**ser001)** in the appropriate fields.
3. Click **OK**.

The service functions available on the Service menu are also available on the **Tools** > **Service** menu. Admin and Service users have access to the same service functions on the **Tools** > **Service** menu.

Additional Tools menus available to the Service login are Factory Defaults and Library Tests. These Tools menus are not available to the Admin login.

The Service Library menu, on the Web User Interface, includes additional functions for capturing logs, viewing/updating library and drive firmware, and executing Key Path Diagnostics. From the Operator Panel: **Tools** > **Service**

Tools –> Service Menu: Drive Tests

Drive Tests: SCSI or Fibre Channel Wrap Tests

This section provides information about SCSI and Fibre Channel Wrap Tests.

Tools/Materials that are required: SCSI, Fibre Channel, or SAS Wrap Tool

These instructions pertain to the **SCSI** or **Fibre Interface**.

1. Ensure that the library and drives are offline to ALL ATTACHED HOSTS. See “Taking the Drives/Library Online/Offline” on page 6-39.
2. Remove the SCSI or Fibre Channel cables from the drive being tested.
3. For a Fibre drive, install the Fibre Channel wrap tool to the Fibre Channel connector of the drive being tested.
4. For a SCSI drive, install the LVD SCSI terminator to the upper connector, and install the LVD SCSI wrap tool to the lower connector of the drive being tested.

5. Start the SCSI or Fibre Channel Wrap Test by selecting **Tools** > **Service** > **Drives** > **Drive Tests** > **Wrap Test** > **Interface Type** > **Module** > **Drive to be tested**. If you have problems, consider the following options to resolve the issue:
   a. If the wrap test fails, replace the Drive Sled. See "Removing a Drive Sled" on page 7-42
   b. If the wrap test is successful, and you are still having problems, suspect the SCSI or Fibre Channel cables or host adapter.
   c. If the cables/adapter do not fix the problem, call your next level of support.
6. When any problem is resolved, reconnect all cables.
7. As the customer to vary the library and drives online to ALL ATTACHED HOSTS. See "Taking the Drives/Library Online/Offline" on page 6-39

Drive Tests: Wrap Tests: SAS Wrap Test

This section provides information about the SAS Wrap Test.

Tools/Materials that are required: SAS Wrap Tool

These instructions pertain to the **SAS Interface**.

1. Ensure that the library and drives are offline to ALL ATTACHED HOSTS. See "Taking the Drives/Library Online/Offline" on page 6-39.
2. Remove the SAS interface cables from the drive being tested. Port 1 is the right-hand port, as viewed from the rear. Insert the wrap tool in Port 1.
3. Start the SAS Wrap Test by selecting **Tools** > **Service** > **Drives** > **Drive Tests** > **Wrap Test** > **SAS Interface** > **Module** > **Drive to be tested** > **Port to be tested**. (Move the wrap tool to the other port and repeat the wrap test.) If you have problems, consider the following options to resolve the issue:
   a. If the wrap test fails, replace the Drive Sled. See "Removing a Drive Sled" on page 7-42
   b. If the wrap test is successful, and you are still having problems, suspect the SAS interface cables or host adapter.
   c. If the cables/adapter do not fix the problem, call your next level of support.
4. When any problem is resolved, reconnect all cables.
5. Ask the customer to vary the library and drives online to ALL ATTACHED HOSTS. See "Taking the Drives/Library Online/Offline" on page 6-39

Tools –> Service Menu: Drives: Media Tests

This tests the drive functions.

From the Operator Panel: **Tools** > **Service** > **Drives** > **Drive Tests** > **Media Tests**

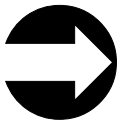
Important: The following tests will overwrite data on the cartridge used. Insert only a scratch (blank) data cartridge or a cartridge that may be over-written. Media must be same as drive type. Ensure media is not write-protected, encrypted, or WORM. The Scratch cartridge must be placed in the top I/O Station slot and assigned to "System" use.

- **Fast R/W Test:** This test reads and writes two wraps worth of data in each of the tape's four data sections. For this test, insert a scratch data cartridge in the top I/O station slot. During the test, the drive overwrites the data on the cartridge. This test takes approximately four minutes (if no error occurs) to 9 minutes (if calibration is required).

- **Media Test:** This test reads and writes two wraps worth of data on each of the two outside data bands on both edges of the tape, for the entire length of the tape, since media damage usually comes from the tape edges. For this test, insert the suspect cartridge in the top I/O station slot. The data will be overwritten on the suspect cartridge. This test takes approximately 9 minutes.
- **Read/Write Test:** This test reads and writes 96 wraps worth of data in each of the tape's four data sections. For this test, insert a scratch data cartridge in the top I/O station slot. During the test, the drive overwrites the data on the cartridge. This test takes approximately 18 minutes.
- **Self Test:** This test performs the drive's Power On Self Test (POST) to make sure that drive hardware is working properly. For this test, insert a scratch data cartridges in the top I/O station slot. This test takes approximately two minutes.

Service Menu: Drives: Reset

This test resets (power cycles) the drive without removing it from the library.



From the Operator Panel: **Tools** > **Service** > **Drives** > **Drive Tests** > **Reset** > **Select Module(s)** > **Select Drive(s)** > **Reset**

Some hardware or firmware failures may require that a drive be reset for recovery from the failure. Drives can be reset individually, by enclosure (module), by logical library (Web User Interface only), or by entire library.

Tools –> Service Menu: System

From the Operator Panel: **Tools** > **Service** > **System**

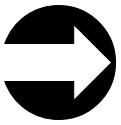
1. Follow the menu path shown above. Touch **Yes** to take all logical libraries OFFLINE.
2. Choose one of the following diagnostic tests and follow the on-screen instructions:
   - Robotics - tests the library robotics (see “DR005: Resolve Motion Failure” on page 5-62)
   - I/O - tests the open/close and lock/unlock sensors of the I/O Station doors (see “DR011: Resolve I/O Station Lock/Unlock Failure” on page 5-64)
   - Bar code - tests the ability of the bar code scanner to read an internal library bar code
   - Door - tests the open/close sensors of the Access Doors. Each Access Door in your library must be tested individually. During the test setup, the diagnostic will lock all of the I/O doors except the I/O door on the module being tested. This provides the diagnostic routine a method of testing all of the module access doors in sequence, even though the door access switches are all connected in series. After closing the Access Door just tested, wait until the library inventory is complete before running the next test or resuming normal library operations.
   - Sensors - tests and displays the sensor status of the main (access) doors, safety loop (module-to-module connectors), I/O stations, and the I/O station

safety flaps. The test also displays the status of the I/O station locks. Press the 'Update' button to re-test the sensors after each change of sensor status.

3. Touch **Back** or **Exit** to return to the Library Verify screen.
4. Touch **Back** to return to the **Service** screen.
5. Touch **Exit** to return to the **Library Offline** screen.
6. Touch **Exit** to exit the **Library Offline** screen and return to the **Tools** menu screen.
7. Touch the **Operations** tab, then touch **Logical Library Mode** to bring your logical libraries back ONLINE.

Tools Menu: Factory Defaults

This operation is only available when logged in to the operator panel as ‘Service’.



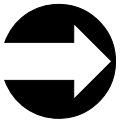
From the Operator Panel: **Tools** > **Factory Defaults**

Attention: This operation will clear all configuration data, including passwords, and reset the library to factory defaults (Clear-to-Ship). The library will be re-booted.

Select **Apply** to perform the operation.

Tools Menu: Library Tests

These diagnostic tests and procedures are only available when logged in to the operator panel as ‘Service'.



From the Operator Panel: **Tools** > **Library Tests**

Installation Verification Test (IVT)

The Installation Verification Test (IVT) is only available to libraries manufactured on or after July 01, 2008. It is available only under Service login under the Tools menu. This test exercises full library capability and functionality after a successful library installation to confirm that an installation or FRU replacement was successful. Manual steps to verify proper installation and physical configuration are still required. Test results are presented on the Op Panel, as well as in the logs which are presented on both the OP Panel and the Web User Interface.

The IVT tests for marginal or failing components/functions, and it is highly recommended that these tests be used only by a product or customer engineer for new installs and new FRU replacement.

The following prerequisites are required for this test:

1. The library should be ready and all hardware installed before the IVT is initiated.
2. The complete library system must be taken offline to avoid interference between IVT and host commands.

3. Drives must be empty before any drive test is initiated.
4. A scratch cartridge must be placed in the top slot of the I/O station, scanned and assigned to ‘System' use. Drive test requires the media type to match the drive type (e.g. LTO4 media for LTO4 drives). This applies to all drive types in the library. Media must not be write-protected, encrypted, or WORM.
5. The type of test must be selected to perform one of the following tests:

- Robot: This procedure tests the following robot parameters: Controller Area Network (CAN) bus; Home; Axis limit; Friction; 4 Corners; Calibration sensor; Alignment; Scanner; Fingers; and Tape Handling.
- Frame: This procedure tests the following frame parameters: Fiducials; Cell positions; Transitions; Configuration.
- I/O: This procedure tests the following I/O station parameters: Door lock mechanism.
- Drive: This procedure tests the following parameters on each drive in the library: CAN Bus test; Drive self test; Put; Load; Fast R/W; Loaded scan; Unload; Unloaded scan; Dismount.
- Tour: This procedure tests the ability of the picker mechanism to load and unload cartridges to and from the extreme top and bottom cells of all of the modules in the library.

At the end of the test(s) selected, you can touch **Details** for all test results, or **Cancel** to exit the Library Tests, or **Next** to view Detail Logs or email Detail Logs.

Library Demo

This test requires a scratch cartridge in the top slot of the I/O station, that has been scanned and assigned to ‘System' use. The test will move this scratch cartridge to random vacant storage cells throughout the library. The test will run continuously, and can be stopped at any time by touching Stop on the display. To exit the test, after the scratch cartridge has been returned to the I/O station, touch Close.

View Last Summary Log

This procedure displays the last test summary log on the operator panel display.

View Last Detailed Log

This procedure displays the last test detailed log on the operator panel display.

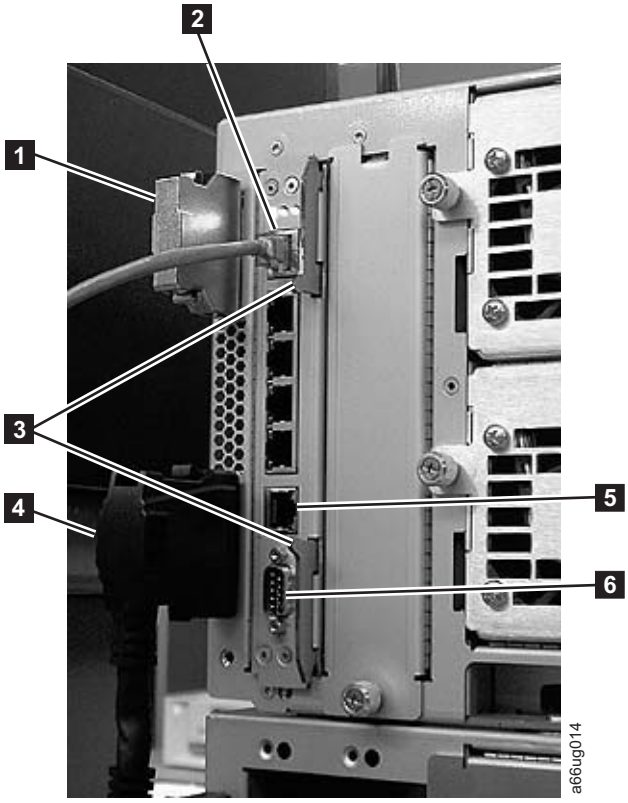
E-mail Last Detailed Log

This procedure e-mails the last test detailed log. SMTP (Mail) Configuration must be set up on the web user interface.

Using the Service Port

The Library Control Blade (LCB) provides an ethernet port that is reserved for use by service personnel. When servicing a library, connect your laptop to this port to access the Web User Interface.

To connect your laptop to the service port:



1. If necessary, close down your laptop's firewall and wireless network connection.
2. Install an Ethernet crossover cable between the laptop and the Ethernet service port (**5**) on the LCB.
3. Open a command window on the laptop. Select **Start** > **Run**, type **cmd**, and click **OK**.
4. Release the current DHCP lease by typing **ipconfig /release**.

   Note: The Service Port defaults as a DHCP (Dynamic Host Configuration Protocol) server.
5. Renew the lease by typing **ipconfig /renew**.
   - Windows informs you when a new lease has been obtained.
   - The IP address of the laptop should be in the 10.10.10.x range.

```
C:\>ipconfig /release
Windows IP Configuration
Ethernet adapter Local Area Connection 2:
Connection-specific DNS Suffix . :
IP Address . . . . . . . . . . . . : 0.0.0.0
Subnet Mask. . . . . . . . . . . . : 0.0.0.0
Default Gateway. . . . . . . . . . :
Ethernet adapter AGN Virtual Network Adapter:
Connection-specific DNS Suffix . :
IP Address . . . . . . . . . . . . : 0.0.0.0
Subnet Mask. . . . . . . . . . . . : 0.0.0.0
Default Gateway. . . . . . . . . . :
C:\>ipconfig /renew
Windows IP Configuration
Ethernet adapter Local Area Connection 2:
Connection-specific DNS Suffix . :
IP Address . . . . . . . . . . . . : 10.10.10.100
Subnet Mask. . . . . . . . . . . . : 255.255.255.0
Default Gateway. . . . . . . . . . :
Ethernet adapter AGN Virtual Network Adapter:
Connection-specific DNS Suffix . :
IP Address . . . . . . . . . . . . : 0.0.0.0
Subnet Mask. . . . . . . . . . . . : 0.0.0.0
Default Gateway. . . . . . . . . . :
C:\>
```

6. Type **ping 10.10.10.1** to verify your connection to the library. If the ping is not successful, repeat steps 4 and 5.
7. Open Internet Explorer.
8. Type in the IP Address, **10.10.10.1**.
9. Type in your service username and password.

Methods of Capturing Logs

IBM Service Personnel should capture logs using the library's service port (see “Capturing a Library Log using the Service Port” on page 6-12). Choose one of these methods for retrieving library and drive logs using the Web User Interface, or a SCSI or Fibre Channel Interface:

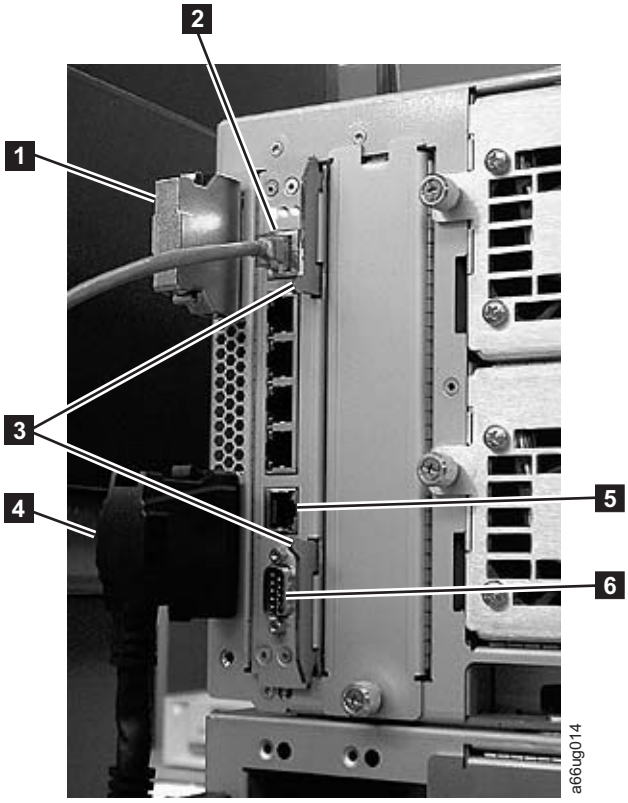
Table 6-1. Methods of Capturing Drive Logs

Type of Error Log	Operator Panel	Web User Interface	SCSI/Fibre Interface
Library	Not available	**Service Library->Capture Library Log**	NTUTIL or TapeUTIL (For more information on these tools, refer to the device driver documentation shipped with your library.)

Table 6-1. Methods of Capturing Drive Logs (continued)

Type of Error Log	Operator Panel	Web User Interface	SCSI/Fibre Interface
Drive	Not available	**Service Library->Capture Drive Log**	• "Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool" on page 6-28 • NTUTIL or TapeUTIL (For more information on these tools, refer to the device driver documentation shipped with your library.)

Capturing a Library Log using the Service Port



Note: Ensure your browser pop-up blocker is disabled when downloading the Log file. Pop-up blockers will prevent the File Download dialog box from opening.

1. Perform the steps in "Using the Service Port" on page 6-9.
2. From the Web User Interface, select **Service Library** > **Capture Library Logs**.
3. Click the **Download the file using the browser** button to begin downloading the library log.
4. Click the **Capture Log** button.

Emailing Logs

Logs provide a summary of the current status of the library, and include configuration settings and information provided in Operator Interventions.

To email current logs:

1. To capture a library log from the Web User Interface, select **Service Library** > **Capture Library Log**
2. Click the **Email the file to** button and enter the email address in the entry field.
3. Click the **Capture Log** button.

Resetting the Admin Password

The default customer Admin password is **secure**, but the customer can change it. If they forget what they changed it to, they need to call Service for a reset.

You will change the password the same way a customer would, only via the Service menu.

1. Log in as a Service user using the default Service login and password.
2. Go to the user management screen as follows:
   - From the Operator Panel, select **Setup** > **User Mgmt** > **Modify User**.
   - From the Web client, select **Manage Access** > **Users**.
3. Follow the screens to modify a user, choosing **Admin** as the user to modify.
4. Enter the new password twice, in the **Enter Password** and **Confirm Password** text boxes.
5. If using the Operator Panel, in the **Current Password** text box, enter the service password you used to log in, then click **Apply**.
6. If using the Web client, click the **OK** button.

Saving/Restoring System Configuration

The Save/Restore Configuration operation is available only on the web client. The path to open the appropriate screen is from the Web User Interface: **Manage Library** > **Settings** > **Save/Restore Configuration**

Note: Ensure your browser pop-up blocker is disabled when saving the System Configuration. Pop-up blockers prevent the File Download dialog box from opening.

Administrative users can save a copy of the current configuration to an external file, or restore a saved configuration file from the external file. The system configuration should be saved before and after any procedures that might affect the configuration of the library, such as updating library or drive firmware or installing any new hardware or firmware features.

The save and restore operation can be used to restore the library's configurable items to a previous state when the library is in a known working state. Do **not** do the Save operation if the library is experiencing a problem.

Note: You cannot restore a saved configuration after removing or replacing a control module or expansion module. After removing or replacing the module, save the library configuration for future use.

Note: The Saving and Restoring operation should not be performed concurrently by multiple administrators logged in from different locations. You can access the screens, but you cannot apply changes while another administrator is performing the same operation.

The file that is saved contains the entire system configuration, plus a copy of the current version of library firmware.

Following is a partial list of the configuration items that are saved:

- Current library firmware
- Network settings:
  - IP address
  - Subnet Mask & Gateway addresses
- Feature Code licenses keys
- Logical library configuration
- Cartridge slot assignments
- Cleaning slot configuration
- I/O Station configuration
- Drive IDs:
  - SCSI ID
  - Fibre Loop ID
  - SAS ID
- Encryption method selections
- Administrator and user account information

Limits on Restoring a Saved Configuration

If your library is running firmware version 600G or later, you can restore a saved configuration that was created with firmware version 410G or later. If you need to restore a configuration created with a firmware version earlier than 410G, contact IBM Technical Support.

Key Path Diagnostics

From the Web User Interface: **Service Library** > **Key Path Diagnostics**

An Encryption Key path diagnostic function is provided to assist the Administrative user in the setup, configuration, or troubleshooting of Library Managed Encryption (LME) enabled libraries. This diagnostic consists of four tests:

1. Drive Test – This is a drive communication test to ensure that the Library-Drive Interface (LDI) is functioning properly.
2. Ethernet Test – This is a key server 'ping' test of all IP addresses associated with LME configured drives.

3. Key Path Diagnostic – This is a communication test used to establish a link to a key manager and ensure that the communication paths between each drive and the EKM have been correctly installed and setup.
4. EKM Config Test – This is a final test to establish a link to a key manager and request a default key. This ensures that the drive has been correctly configured in the EKM to service key requests.

To execute Key Path Diagnostics, from the web UI, go to **Service Library** > **Key Path Diagnostics** and click **Start Tests**.

These tests are run sequentially on each IP address of each drive that is enabled for LME. If a particular test fails, the subsequent tests for that same IP address are not run, and the results will show N/A.

Note: The diagnostics tests may take several minutes to complete. To run any of the tests, the tape drive used for the test must be unloaded, ready, and online.

If any of the tests fail, try the following resolutions and run the test again to make sure it passes:

- Ping Test Failure - Verify that the key server host is running and accessible from the network the library is on.
- Drive Test Failure - Look for any tape drive RAS tickets and follow the resolution instructions in the ticket.
- Path Test Failure - Verify that the key server is actually running and that the port/SSL settings match the library configuration settings.
- Config Test Failure - Verify that the key server is set up to accept the tape drive you are testing.

There are two ways to perform Key Path Diagnostics:

- "Using Key Path Diagnostics" on page 6-16
- "Using Periodic Key Path Diagnostics" on page 6-16

The following list describes some important factors about Key Path Diagnostics:

- The Key Path Diagnostics take affected partitions offline.
- The Periodic Key Path Diagnostics do not take partitions offline, but it can delay moves to tape drives while they are being tested.
- The Periodic Key Path Diagnostics tests every connected EKM server in turn, and the library selects the tape drive to use for each test. If the selected tape drive is not available (it must be unloaded, ready, and online), then the library tries another tape drive that is connected to the key server until it finds one that is available. If no tape drives that are connected to a particular key server are available, then that server is skipped and the tests are not performed. If a server is skipped for "X" number of consecutive test intervals (where "X" is configurable on the Web client), the library generates a RAS ticket. If a tape drive remains loaded for a long time, it is possible that it will never be tested. If you want to test a specific tape drive or if you replace a tape drive, run the Key Path Diagnostics manually.
- To view the status of the Key Path Diagnostics, from the web user interface, select **Monitor System** > **Key Path Diagnostics**.

Using Key Path Diagnostics

Note: Tape drives must be unloaded, ready, and online in order for the test to run.

To use Key Path Diagnostics:

1. From the web UI, select **Service Library** > **Key Path Diagnostics** to enter Key Path Diagnostics. Note that entering Key Path Diagnostics will log off all other users of the same or lower privileges and take your partitions offline. When you exit Key Path Diagnostics, the partitions automatically come back online. A list of all the tape drives enabled for library-managed encryption is displayed, along with the tape drive status and the partition in which each tape drive resides.
2. Select the tape drive on which you want to perform diagnostics and click **Apply**. A dialog box appears telling you that the selected partition will be taken offline.
3. Click **OK** to start the diagnostics.
4. The library performs the diagnostics and displays pass or fail results on each of the tests in the Progress Window.

   Note: The diagnostics tests may take several minutes to complete.
5. Do one of the following:
   - If "Completed" appears in the Progress Window, the diagnostics were performed (this does not mean that the diagnostics passed, just that the diagnostics were performed). Click **Close** to close the Progress Window.
   - If "Failure" appears in the Progress Window, the diagnostics were not able to be performed. Follow the instructions listed in the Progress Window to resolve any issues that occurred during the operation.

Using Periodic Key Path Diagnostics

You can enable the library to automatically perform Key Path Diagnostics at selected intervals. During each interval, the library tests every configured key server. The default test interval is four hours. The library generates a RAS ticket if there are problems.

Periodic Key Path Diagnostics is disabled by default. It is recommended that you leave Periodic Key Path Diagnostics disabled, unless network interruptions are a common cause of encryption failures at your site.

Attention: Running Periodic Key Path Diagnostics may cause an increase in RAS tickets if tests are skipped due to tape drives being unavailable for a configurable number of consecutive test intervals. To reduce the occurrences of RAS tickets, you can specify the number of consecutive test intervals required to generate a RAS ticket to a higher number, or you can set the library to never generate a RAS ticket for missed test intervals.

To enable Periodic Key Path Diagnostics:

1. From the web user interface, select **Service Library** > **Key Path Diagnostics**.
2. Select **Enable Periodic Key Path Diagnostics**.
3. Select a test interval from the **Test Interval** list.
4. Check **Enable Test Delay Reporting** if you want the library to generate a RAS ticket to inform you that the test could not be performed within the specified number of test intervals.

- If you check **Enable Test Delay Reporting**, from the **Test Delay Reporting Threshold** list, select the number of consecutive, missed test intervals that are required before the library generates a RAS ticket. You can select any value from 1 to 24. The default threshold is 3.
- If you do not check **Enable Test Delay Reporting**, the library will never generate a RAS ticket, no matter how many tests are missed.

Enabling Drive Logical Serial Number Addressing

From the Operator Panel: **Tools** > **System Settings** > **Logical SN Addressing**

Administrative users can enable or disable tape driver logical serial number addressing from the Operator Panel only. The default setting is Disabled.

Logical serial number addressing allows the library to assign logical serial numbers to all tape drives in the library. Specifically, the library assigns a logical serial number to a tape drive in a specific location, not the serial number of the particular tape drive. If a tape drive is replaced by another tape drive in the same library location, the logical serial number remains the same. From the host application's perspective, the replacement tape drive is the same as the original. By default, logical serial number addressing is disabled.

This feature can be enabled and disabled from the operator panel by navigating to the **System Settings** screen from the **Tools** tab. If you change the logical serial number addressing setting, you must shut down the library and press the library power button (power cycle the library) or remove power from each tape drive for the change to take effect.

Important: Use caution with this feature, as it can be accessed by both Admin and Service login users. Enabling this feature in an existing installation will change the presentation of the drive serial numbers to the host computer and host applications. Some host operating systems, and some applications software, will no longer see a drive if the serial number changes (by use of this feature) from a previously set host configuration.

It will be necessary to reconfigure the host addressing application to recognize the new tape drive serial numbers.

Interpreting LEDs

Light emitting diodes (LEDs) provide a visual indication about the status of certain library components. LEDs can sometimes communicate that a problem exists when operator interventions cannot. For example, an LED can indicate a firmware problem that prohibits the library from generating operator interventions.

The following components of the library have LEDs:

- "Power Button LEDs" on page 6-18
- "Library Control Blade LEDs" on page 6-18
- "Tape Drive LEDs" on page 6-20

- "Power Supply LEDs" on page 6-22
- "Picker LED" on page 6-23

Some of these components may also include a fibre port link LED.

Power Button LEDs

Two LEDs are located to the right of the library's power button (**1**) on the front panel of the control module.

Figure 6-1. Power button LEDs

- Green power ON LED (**2**) - When lit, this LED indicates that the library power is ON.
- Amber Operator Intervention Alert LED (**3**) - When lit, this LED indicates that there is a Library, Drives, or Media Operator Intervention available. To view the Operator Intervention, select **Tools** > **Operator Intervention** from the Operator Panel.

Library Control Blade LEDs

The library contains a Library Control Blade (LCB). LEDs are used to indicate the status of the LCB.

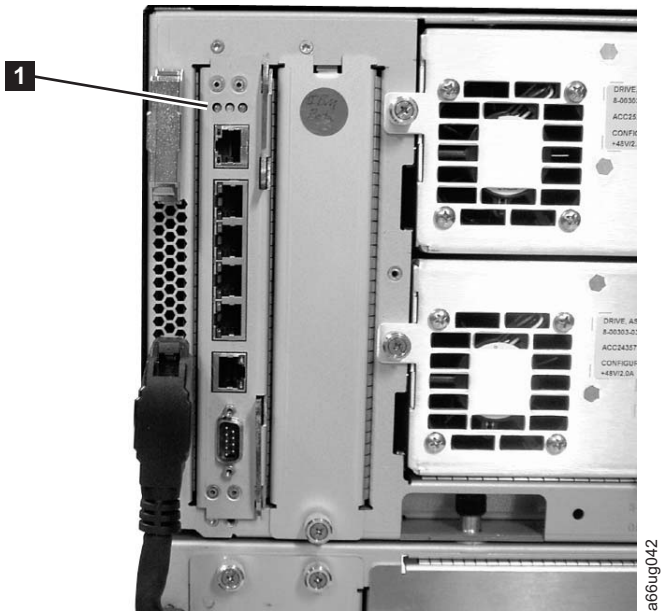


Figure 6-2. Library Control Blade LEDs

LCB LEDs (**1**) indicate status by the rate at which they blink. The color of the LED identifies the area of the component being reported.

Use the following table to interpret the current status of LCB LEDs:

Table 6-2. LCB LEDs

LED Color	Represents	Blade Status
Green	Processor status	• Solid ON - Processor not operating • Solid ON for 3 seconds, then blinks twice - LCB firmware is downloading • 1 blink per second - Normal: Processor operating • 10 blinks per second - Identify mode • Solid OFF - Processor not operating
Amber	Health status	• 1 blink per second - Main processor not operating • Solid OFF - Normal: Blade operational
Blue	Power control status	• Solid ON - Swap mode: LCB is powered down and can be removed • 1 blink per 10 seconds - Normal: LCB on • Solid OFF - LCB not receiving power

Note: If all three LEDs are solid ON for at least twenty minutes, suspect a bad or corrupt compact flash. See "Library Control Blade or Compact Flash Card" on page 7-44.

Amber LED on Library Control Blade

Under normal operating conditions, the amber LED on a Library Control Blade (LCB) is not lit. If you see that the amber LED on an LCB is either blinking

continuously or solidly lit for at least 20 minutes, service the LCB as soon as possible. The library may or may not generate an operator intervention, depending on the source of the problem.

Attention: Never remove an LCB when its amber LED is solidly lit, unless it has been solidly lit for at least 20 minutes.

The following table indicates the actions you can take, based on the condition of the LED.

Table 6-3. Amber LED on an LCB

State of Amber LED	Suggested Service Action
Solid ON for 20+ minutes	Replace the LCB.
1 blink per second	Check the firmware for the LCB and make sure that you have the most current firmware available (visit **http://www.ibm.com/storage/lto**. Do not replace the LCB. It is unlikely that the LCB hardware is the source of the problem.

Servicing a Library Control Blade Based on LED Status

When servicing a blade based on the status of an LED:

1. Observe the blinking patterns of the LEDs for at least 30 seconds, and log your observations in both the operator intervention and the equipment failure report that you must return with the defective part. Accurate reporting of all LED states for the entire green, amber, and blue set of LEDs is critical for diagnosing the cause of the problem.
2. Generate a current log of the library, and send it to technical support for analysis.

Library Configuration Form: Make a copy of this form, fill it out as you are installing and configuring your library. Update the form each time changes are made to the library. The information on this form is very important. You can also save your libraries configuration data from the web user interface (see "Saving/Restoring System Configuration" on page 6-13). Having the information on this form will be helpful if a call to IBM Service is necessary. Store this form in a secure location.

Tape Drive LEDs

Operator interventions typically report all problems related to tape drives, including error codes and tape alerts. By observing the blinking pattern of LEDs on tape drives, however, you can discern which operation the tape drive is currently performing.

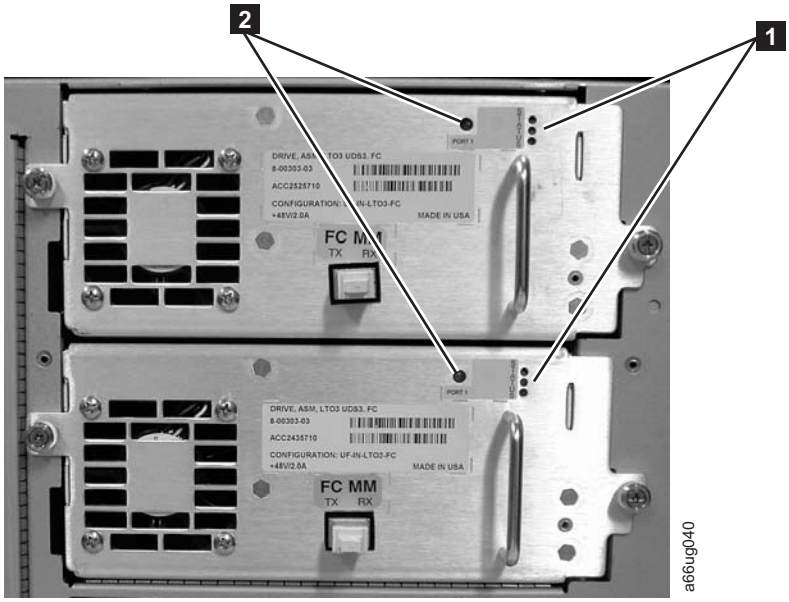


Figure 6-3. Tape drive LEDs

Use the following table to interpret tape drive activity by observing tape drive LEDs (**1** in Figure 6-3).

Table 6-4. Tape Drive Activity

LED Color	Represents	Drive Status
Green	Processor activity	• Solid ON - Drive's main processor is not operating • Solid ON for 3 seconds, then blinks twice - Drive firmware is downloading • 1 blink per second - Normal: Drive operational • Blinks 3 times in 3 seconds, then pauses (solid OFF), and then repeats - Drive is activating (varying online) • 10 blinks per second - Identify mode • Solid OFF - Drive's main processor is not operating
Amber	Health of the drive	• Solid ON - Drive has failed • Solid OFF - Normal: drive operational
Blue	Power control	• Solid ON - Drive is powered down and ready to be replaced or varied online • 1 blink per 10 seconds - Normal: Drive operational • Solid OFF - Drive is not receiving power

Fibre Port Link LED

The fibre port link LED (**2** in Figure 6-3) shows the current state of the fibre channel link and indicates whether or not the link is ready to transmit commands.

Use the following table to interpret fibre channel link activity.

Table 6-5. Fibre Port Link LED on Tape Drive

LED Color	Represents	Fibre Port Link Status
Green	LIP and activity	• Solid ON - Loop Initialization Protocol (LIP) has occurred. • Blinks at regular intervals - Host command/data activity is occurring.
Amber	Online and light detected	• Solid ON - The library has enabled the drive data bus, and it can detect light through a fiber optic cable.
No color	No activity or no light detected	• Solid OFF - Either the drive is off or the drive cannot detect light through a fiber optic cable (which is equivalent to a missing fibre cable). If the drive is varied OFF, the blue status LED will be solidly lit.

Power Supply LEDs

Operator interventions typically report all problems related to power supplies. You can also observe the blinking pattern of LEDs on power supplies to see if they are functioning correctly.

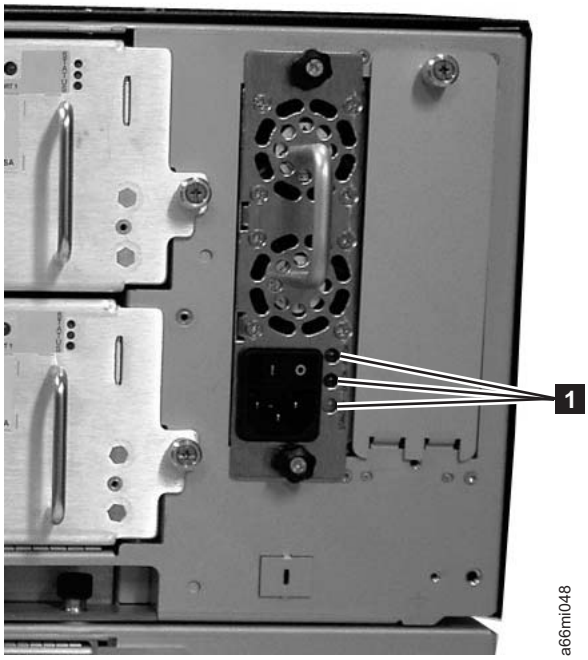


Figure 6-4. Power supply LEDs

Power supply LEDs indicate status by the rate at which they blink. The color of the LED identifies the area of the component being reported.

Table 6-6. Power Supply LEDs

LED Color	Represents	Power Supply Status
Green	AC OK (top)	• Solid ON - The power supply's AC input is above the minimum requirements to operate. • Solid OFF - The power supply's AC input is below the minimum requirements to operate.
Green	DC OK (middle)	• Solid ON - The power supply's output voltage is within regulation. • Solid OFF - The power supply's output voltage is not within regulation.
Blue	Fault (bottom)	• Solid ON - Indicates that one of the following faults has been detected: – Power supply is outside of specifications – Current limit has been exceeded – Temperature limit has been exceeded – Fan failed while AC input is present and above the minimum operating voltage – AC input is below the minimum operating voltage – The power supply is ON, the Power button ON, but the library's indicator panel is OFF • Solid OFF - Normal: No faults detected

In the operator intervention associated with the defective power supply, record both the number of the module and the number of the power supply connected to that module.

Each module can have up to two power supplies. When viewed from the rear, the power supply on the left is considered to be #1, while the power supply on the right is #2.

Modules are numbered according to their position in relation to the control module (CM).

Picker LED

Both the Original and the M2 Picker Assembly have one green LED, seen in the following images (**1** in Figure 6-5 on page 6-24) that must be ON for the Picker to function properly. If the LED is not lit, the Picker assembly should be investigated for problems (module-to-module communication cable is not in place, module communication terminator is not in place, an Access Door is open).

To observe the status of the Picker LED:

1. Look through the viewing window on the front of an expansion module and determine whether or not the Picker LED is ON.
2. If you cannot see the Picker LED, power OFF the library. The Picker will move to the bottom of the library.
3. Power ON the library.
4. Open the lowest I/O Station door in your library and, looking through the opening to the left of the flap inside the I/O Station, observe the Picker LED.

Note: Do not open the Access Door to observe the Picker LED. If the Access Door is opened, the Picker LED is turned OFF.

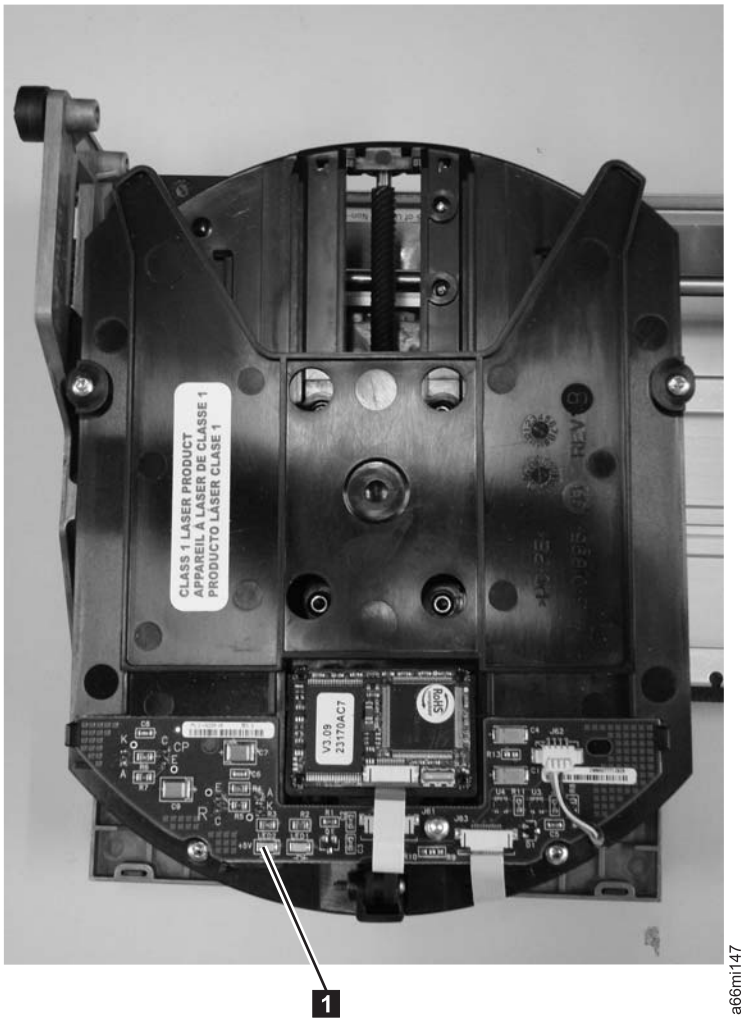


Figure 6-5. Location of Original Picker Assembly LED

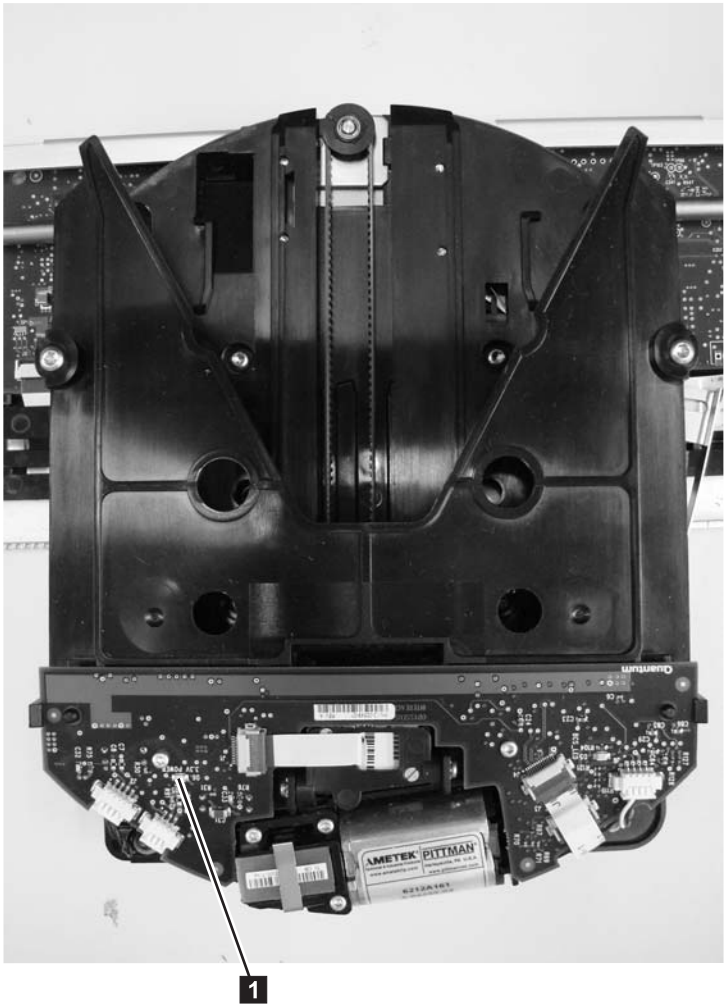


Figure 6-6. Location of M2 Picker Assembly LED

Methods of Updating Firmware

Important: When updating firmware:

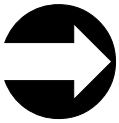
- Ensure all host applications are varied offline.
- Do not power-off the library until the update is complete, or the firmware may be lost.

Periodically check for updated levels of firmware by visiting the web at **http://www.ibm.com/storage/lto**. Update firmware using:

Type of Firmware	Operator Panel	Web User Interface	SCSI/Fibre Interface
Library	Not Available	**Service Library->View/ Update Library Firmware Level** (This operation can take as long as 30 minutes.)	

Type of Firmware	Operator Panel	Web User Interface	SCSI/Fibre Interface
Drive	**Tools->Drive Mgmt->Update Drive Firmware** (using an FMR cartridge)	**Service Library->View/ Update Drive Firmware Level**(This operation can take as long as 25 minutes for a single drive and 35 minutes for two to eighteen drives).	"Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool" on page 6-28 or "Other Methods for Updating Drive Firmware through the SCSI or Fibre Channel" on page 6-29

Updating Library Firmware



From the Web User Interface: **Service Library** > **View/Update Library Firmware Level**

Note: Ensure your browser pop-up blocker is disabled when updating the library firmware. Pop-up blockers will prevent the Browse dialog box from opening.

Administrative users can use the **Update Library Firmware Level** command to download firmware to the library. Updating library firmware can be performed only from the Web User Interface.

Important: Before updating firmware,

- Resolve and close all open Operator Interventions.
- Save the current system Configuration. See "Saving/Restoring System Configuration" on page 6-13.

To update library firmware:

1. Download the latest level of library firmware to your host computer by visiting http://www.ibm.com/storage/support/.
2. From the Web User Interface, select **Service Library** > **View/Update Library Firmware Level**.
3. Browse to the file on your computer, select the ".tgz" file that was downloaded from the IBM web site, then click the **Update Firmware** button. The Web User Interface will indicate that the operation has completed. This means that the firmware file has been successfully moved from the host computer to the library.
4. Wait for the library to reboot before resuming normal library operations. It will be several minutes before the library reboots.
5. Save the current system Configuration. See "Saving/Restoring System Configuration" on page 6-13

Important: After the update process starts, you must wait until the library reboots. Do not attempt to interrupt the process in any way, or the upgrade will not be successful.

Updating Drive Firmware

Drive firmware is best updated using the drive's application interface, SCSI or fibre.

Important: Before updating firmware,

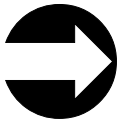
- Resolve and close all open Operator Interventions.
- Save the current system Configuration. See "Saving/Restoring System Configuration" on page 6-13.

You can update drive firmware through the library's Web User Interface. For more details, see "Updating Drive Firmware Using the Web User Interface"

Alternatively, you can update drive firmware with any of the readily available tools. For example, ITDT is available for multiple platforms and requires no special device drivers. You can download ITDT from the IBM web site (refer to "Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool" on page 6-28). Other tools, such as NTUTIL and TapeUTIL can also be used for drive firmware updates.

The library also supports drive firmware update by creating and using an FMR cartridge. However, to create an FMR cartridge with the latest drive firmware, one of the methods described above must be used to first download the firmware to one of the drives. An FMR cartridge can then be created and used to update the remaining drives for that drive type, SCSI or fibre. For more information on FMR cartridges, refer to "Updating Drive Firmware Using a Firmware (FMR) Cartridge" on page 6-28.

Updating Drive Firmware Using the Web User Interface



From the Web User Interface: **Service Library** > **View/Update Drive Firmware Levels**

Note: Ensure your browser pop-up blocker is disabled when updating drive firmware. Pop-up blockers will prevent the Browse dialog box from opening.

Administrative users can use the **View/Update Drive Firmware Levels** command to download firmware to the drive.

To update drive firmware:

1. Download the latest level of drive firmware to your host computer by visiting **http://www-1.ibm.com/servers/storage/tape/lto/**.
2. From the Web User Interface, select **Service Library** > **View/Update Drive Firmware Levels**.
3. Select a drive media and interface type.
4. Select the drive(s) to be updated.
5. Click the **Select Action** pull-down menu and select **Update Firmware**. Then select **Go**.
6. Browse to the file on your computer, select the ".ro" file that was downloaded from the IBM web site, then click **Yes** to begin.

7. Save the current system Configuration. See “Saving/Restoring System Configuration” on page 6-13

Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool

A newly designed tool, ITDT, is a tool with multiple functional capability and is a very quick, convenient and efficient method for drive firmware updates. As a note, drive dump retrievals can be performed by the tool as well.

Below are some of the capabilities of this tool:

- Firmware update capability via SCSI to all IBM LTO Tape Drive products.
- The tool does not require any special device drivers.
- The tool is available for most major platforms (Windows, AIX®, SUN, Linux, NetWare).
- The tool is capable of uploading drive dump files.
- The tool's primary function is thoroughly testing a drive. However, if the library is online to the server/host where the tool resides, ITDT will communicate with the drive through the library to load and unload a test cartridge thereby exercising some library functions.
- The tool scans the SCSI bus and will find and display for selection all IBM LTO devices. The tool will not display and allow for selection any non-IBM device.
- Each function has a "Help" selection which explains the required syntax as well as a brief explanation of the particular function.
- A Readme text file will be posted with the .exe for a thorough explanation of initial tool download information from the web as well as explanation of tool capabilities.
- The tool is currently a "command line" tool with a simple entry by keying in the executable name, **itdt**, from the directory where the tool is located.

To download the ITDT tool and instructions for using the tool, visit http://www.ibm.com/storage/support/.

Updating Drive Firmware Using a Firmware (FMR) Cartridge

A firmware (FMR) cartridge is a blank tape cartridge that is used to transfer updated drive firmware code to the library. The drive code image is copied onto the FMR cartridge, which can then be used to update the drive firmware on all of the specified drives within the library. See “Creating a Drive FMR (Firmware) Cartridge” for more information.

Note: A FMR tape for updating a LTO-4 drive must have been created on another LTO-4 drive with the same host interface type (e. g. SAS or Fibre Channel), and likewise, a FMR for updating a LTO-3 drive must have been created on another LTO-3 drive with the same host interface type (e. g. SCSI or Fibre Channel). Each generation of LTO and each attachment type of drive have different firmware images.

Important: Before you update drive firmware during this procedure, make sure that tapes are not mounted in any of the drives. If the cartridges are mounted in drives during the update process, the library loses track of the cartridge home cell in storage, resulting in library and host inventory issues.

Creating a Drive FMR (Firmware) Cartridge:

You must create an FMR cartridge, if you do not already have one, to update drive firmware with this method. FMR cartridges are created using a blank (scratch) data cartridge. To create an FMR cartridge of a drive firmware version already in use in your library, follow the steps below:

1. From the Op Panel, select **Tools → Drive Mgmt→ Create Firmware Cartridge**.
2. Select the drive type and drive from which you want to create the FMR cartridge.
3. When the Operator Panel displays the request, place a blank, scratch cartridge into the top slot of the empty I/O station. If other cartridges reside in the I/O Station, remove them before inserting the FMR cartridge.

   After the I/O Station door is closed, select **System** on the **I/O Assignment** screen. The library moves the media from the I/O station to the source drive and instructs the source drive to create an FMR cartridge from its current code version.

Using a Firmware (FMR) Cartridge to Update Drive Firmware:

1. Load the FMR cartridge in the I/O Station.

   Important: Do not open the I/O Station until the update process finishes.
2. Select **Tools > Drive Mgmt > Update Drive Firmware Using FMR**, then select the drive type and drive(s) you wish to be updated.
   - The library then successively moves this FMR cartridge into each of the specified drives to be updated.
   - The library automatically logs off all users so that they cannot perform library options while the drive firmware update operation is in progress.
   - The library updates the firmware on each targeted drive. After the update finishes, the FMR cartridge is returned to the I/O station. A message notifies you when the update operation is complete.
3. Save the current system Configuration. See “Saving/Restoring System Configuration” on page 6-13

Other Methods for Updating Drive Firmware through the SCSI or Fibre Channel

Attention: Each drive connection type and each generation of drive (LTO3 or LTO4) requires a unique firmware image.

When updating drive firmware by using the SCSI or Fibre Channel interface, the procedure varies, depending on whether your server uses an IBM tape device driver or a non-IBM tape device driver (such as a driver from Sun, Hewlett-Packard, or Microsoft).

For instructions about updating firmware from a server that uses an IBM tape device driver, refer to the *IBM Ultrium Device Drivers Installation and User's Guide*.

To update firmware from a server that uses a non-IBM tape device driver, refer to the documentation for that device.

Checking/Reseating Cables

External Cables

To check or reseat external library cables and terminators, perform the following steps:

1. Locate the cables and terminators by referring to the example figures below.

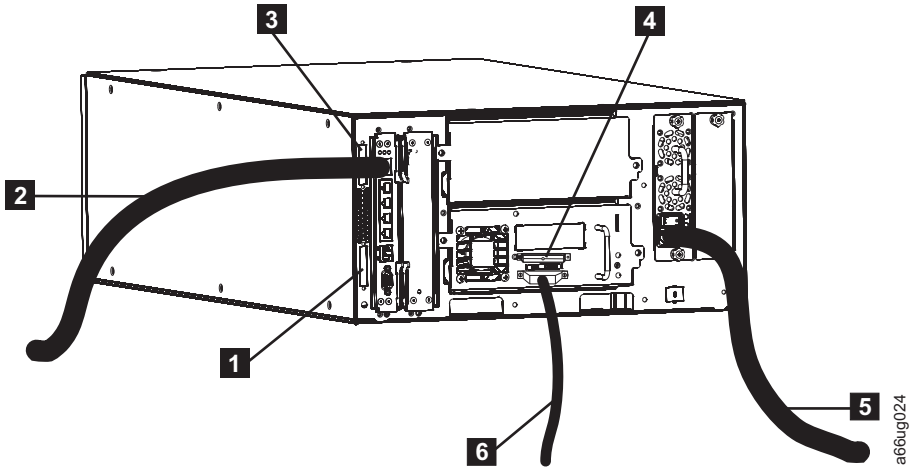


Figure 6-7. Cabling of a 5U Library with SCSI Drives

1	Module communication terminator	3	Module communication terminator	5	Power cord
2	Ethernet cable (customer supplied)	4	SCSI terminator	6	SCSI drive cable

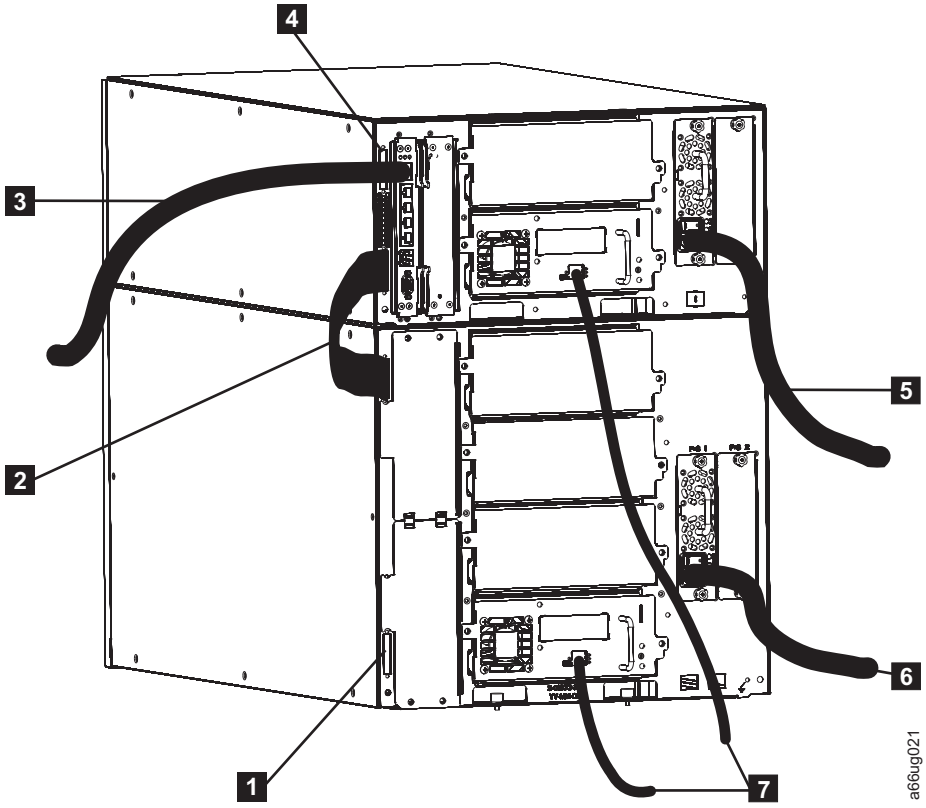


Figure 6-8. Cabling of a 14U Library with Fibre Drives

1	Module communication terminator	4	Module communication terminator	7	Fibre drive-to-network cables
2	Module-to-module communication cable	5	Power cord (upper module)		
3	Ethernet cable (customer supplied)	6	Power cord (lower module)		

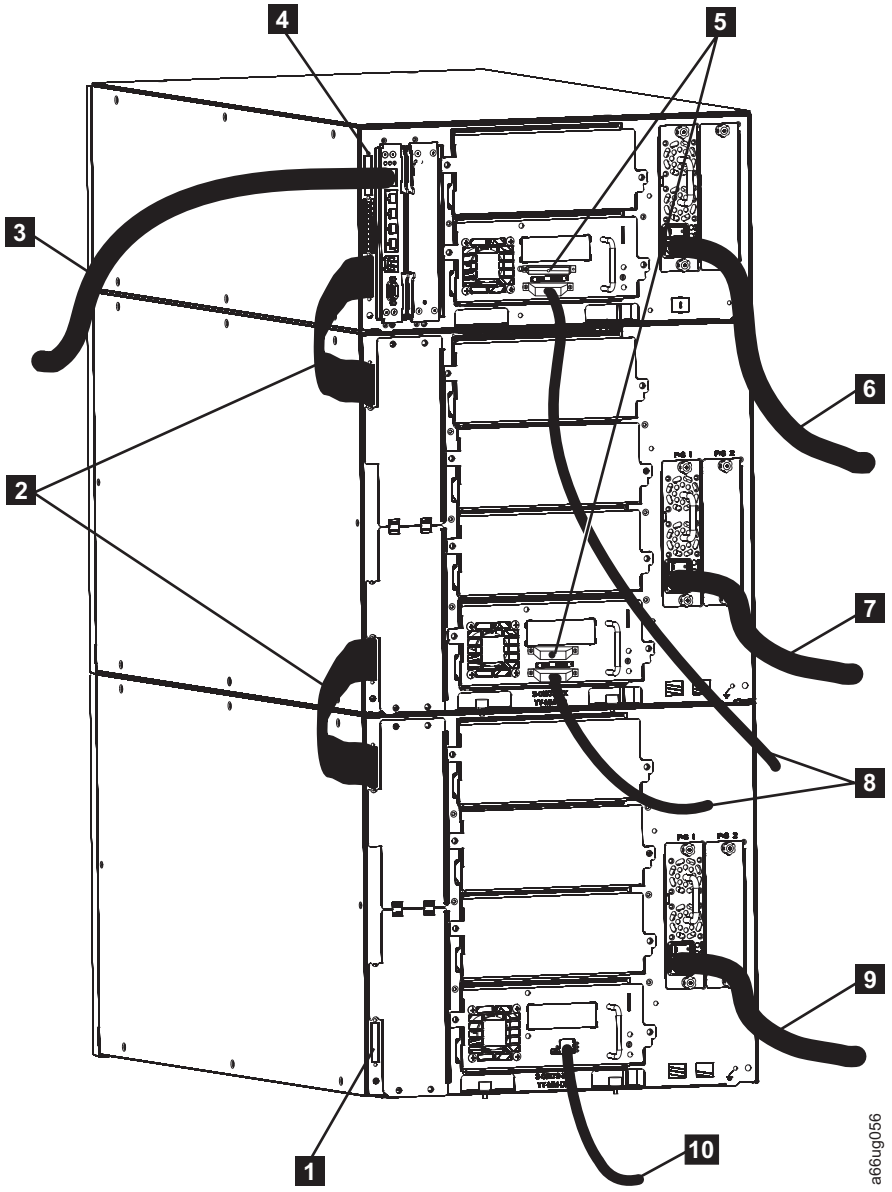


Figure 6-9. Cabling of a Multi-Module Library with SCSI and Fibre Drives

1	Module communication terminator	5	SCSI terminators	8	SCSI drive cables
2	Module-to-module communication cable	6	Power cord (Control Module)	9	Power cord (Expansion Module)
3	Ethernet cable (customer supplied)	7	Power cord (Expansion Module)	10	Fibre drive-to-network cable
4	Module communication terminator				

2. Check and reseat, if necessary, all of the cables and terminators connected to your library.
3. Verify that there is no damage to any connector pins.

Internal Cables

1. Visually check, and reseat if necessary, all of the connectors on the back of the operator panel. See **1**, **3**, **4**, **5**, and **7** in Figure 6-10.

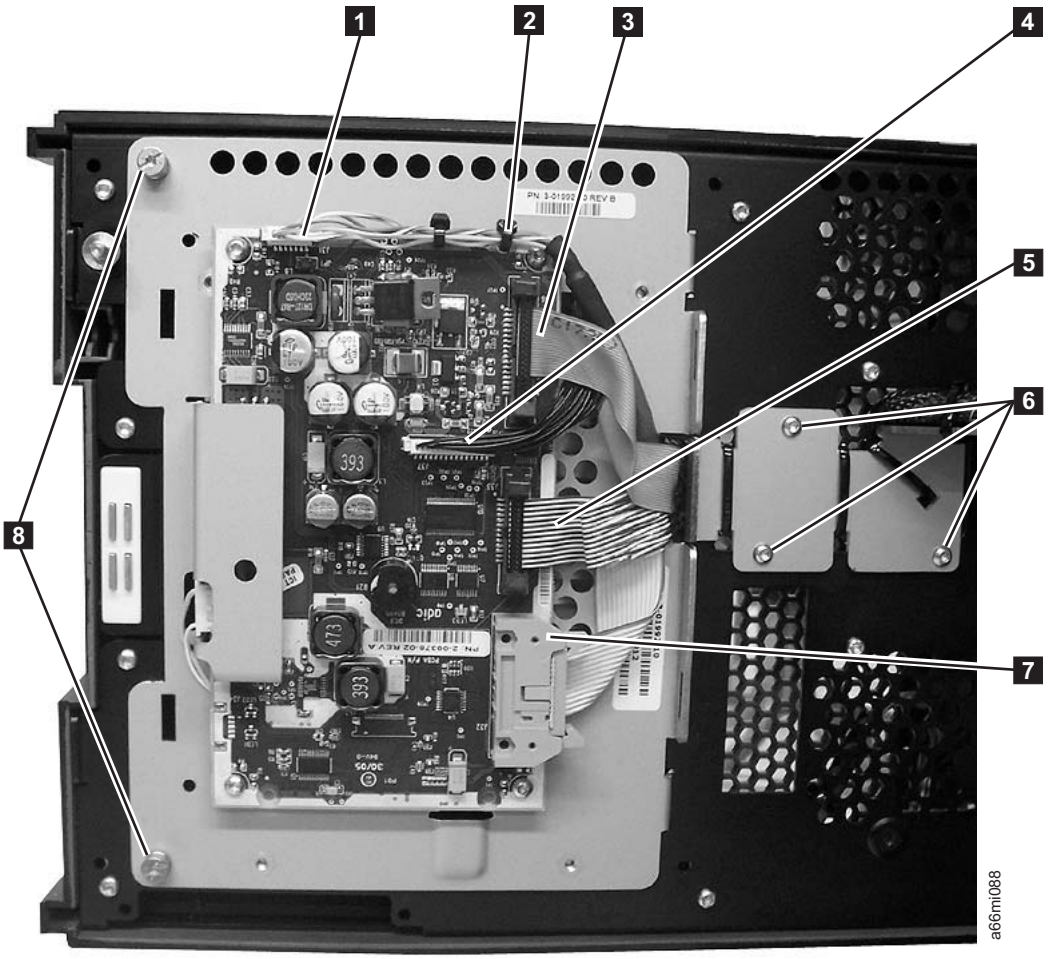


Figure 6-10. Operator panel connectors

2. Visually check, and reseat if necessary, the connector on the back of the I/O Station lock assembly. See **1** in Figure 6-11 on page 6-34.

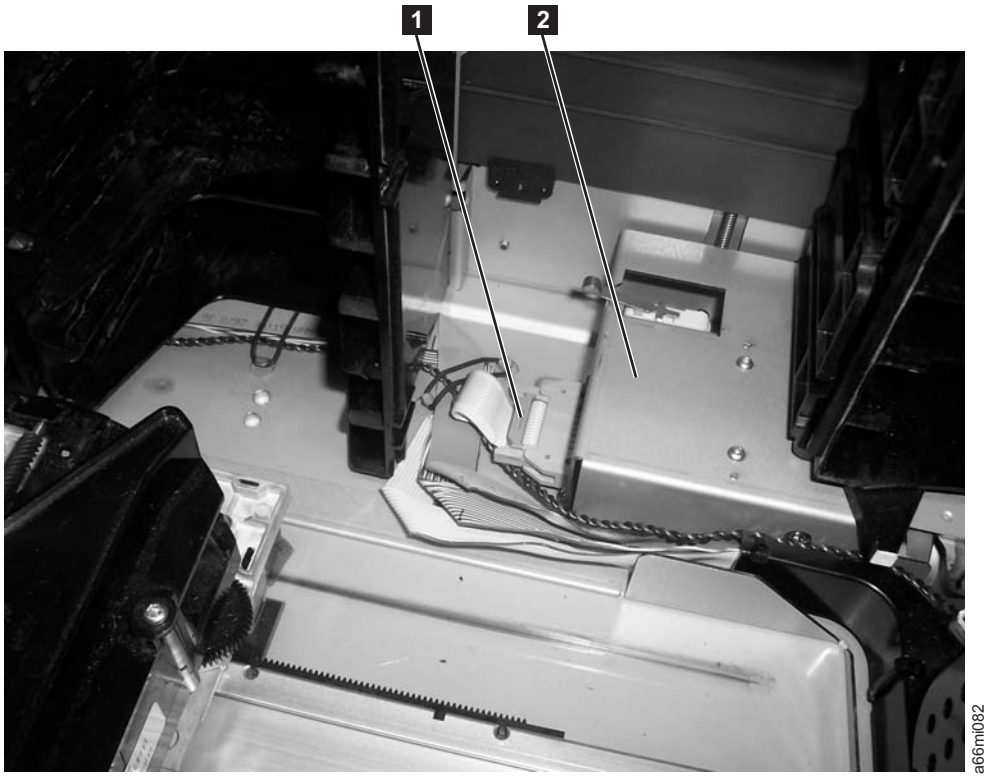


Figure 6-11. I/O Station lock assembly connector (top cover removed)

3. Visually check, and reseat if necessary, all of the connectors on the front of the Backplane Connect Board (BCB). See **1**, **2**, and **3** in Figure 6-12 on page 6-35.

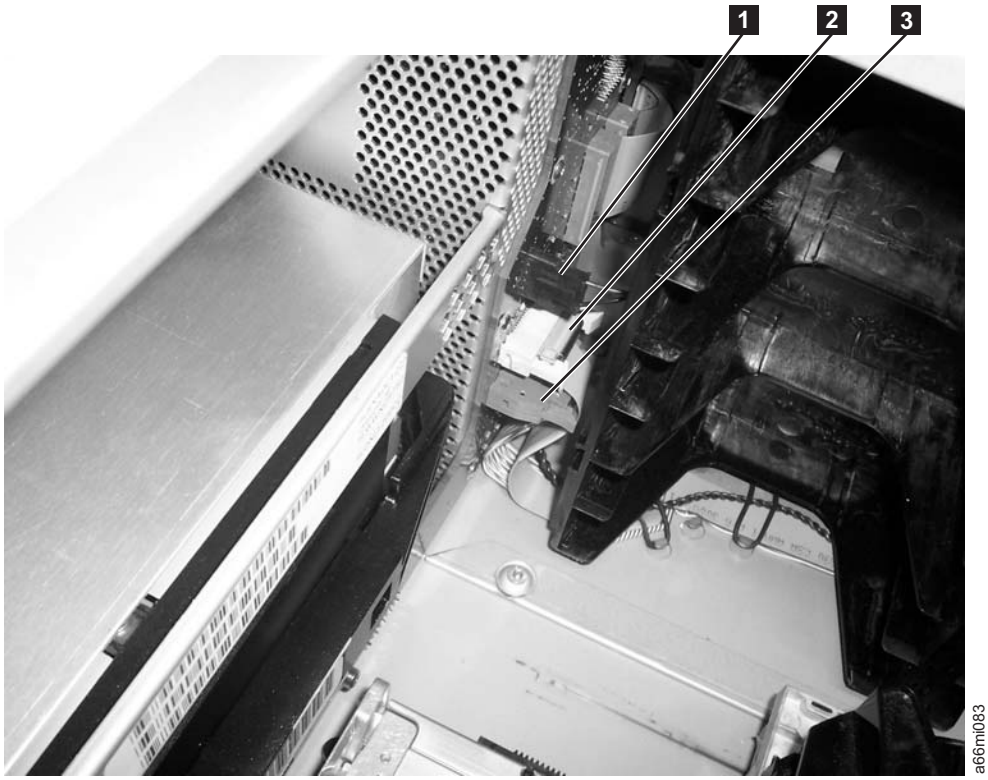


Figure 6-12. Backplane Connect Board connectors (front, top cover removed)

4. Visually check, and reseat if necessary, all of the connectors on the back of the Backplane Connect Board. See **1**, **2**, **3**, and **4** in Figure 6-13.

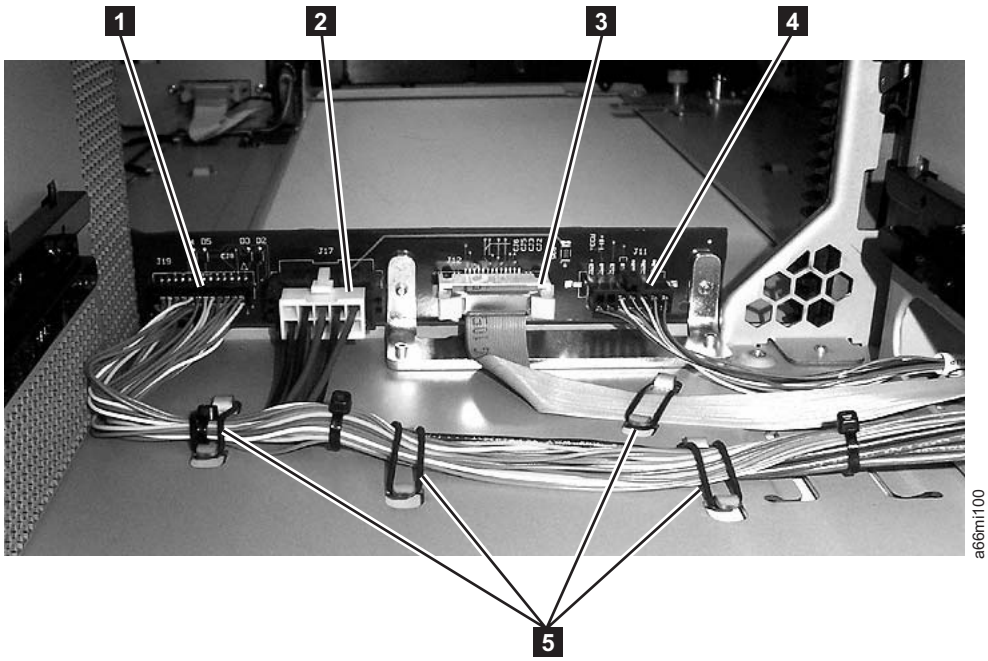


Figure 6-13. Backplane Connect Board connectors (back, drive sleds removed)

5. Visually check, and reseat if necessary, all of the connectors on the Drive Sled Interface Board (DSIB). See **7** and **8** in Figure 6-14.

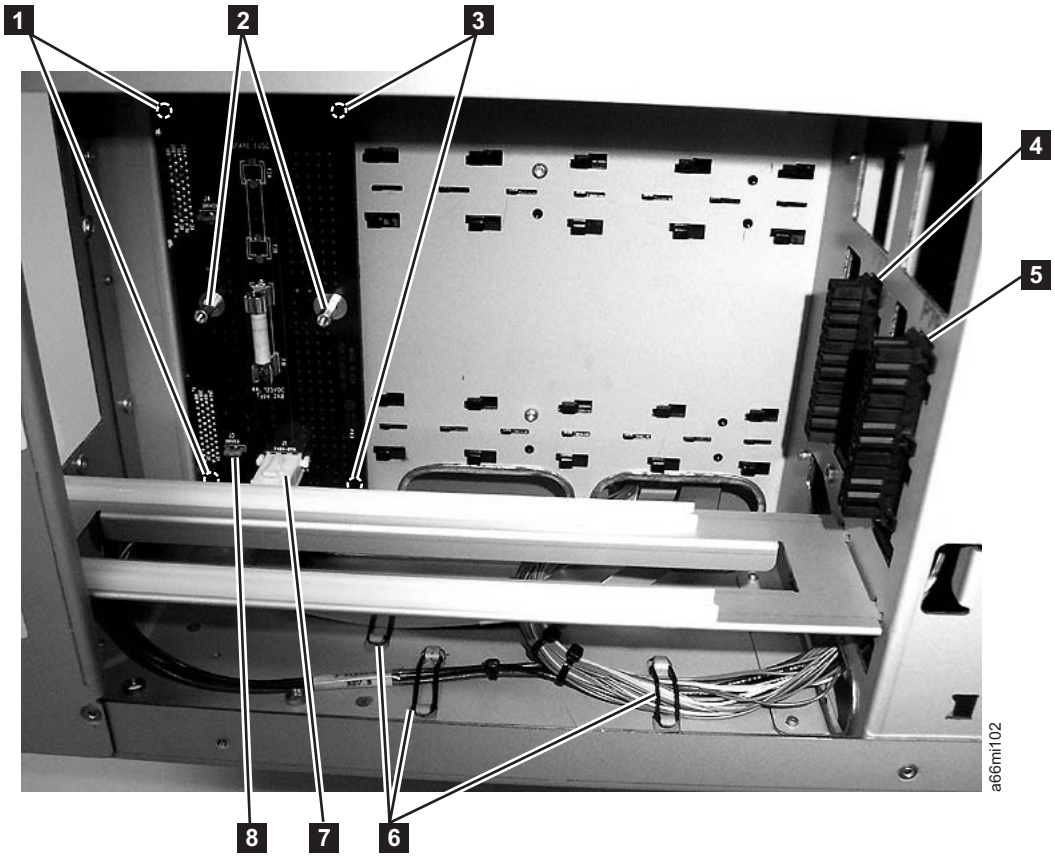


Figure 6-14. Drive Sled Interface Board connectors (side cover removed)

6. Visually check, and reseat if necessary, all of the connectors on the Robot Assembly.
   - For the Robot Assembly, see **1**, **2** and **3** in Figure 6-15 on page 6-37.. For the Picker Assembly, see **1** in Figure 6-16 on page 6-38.

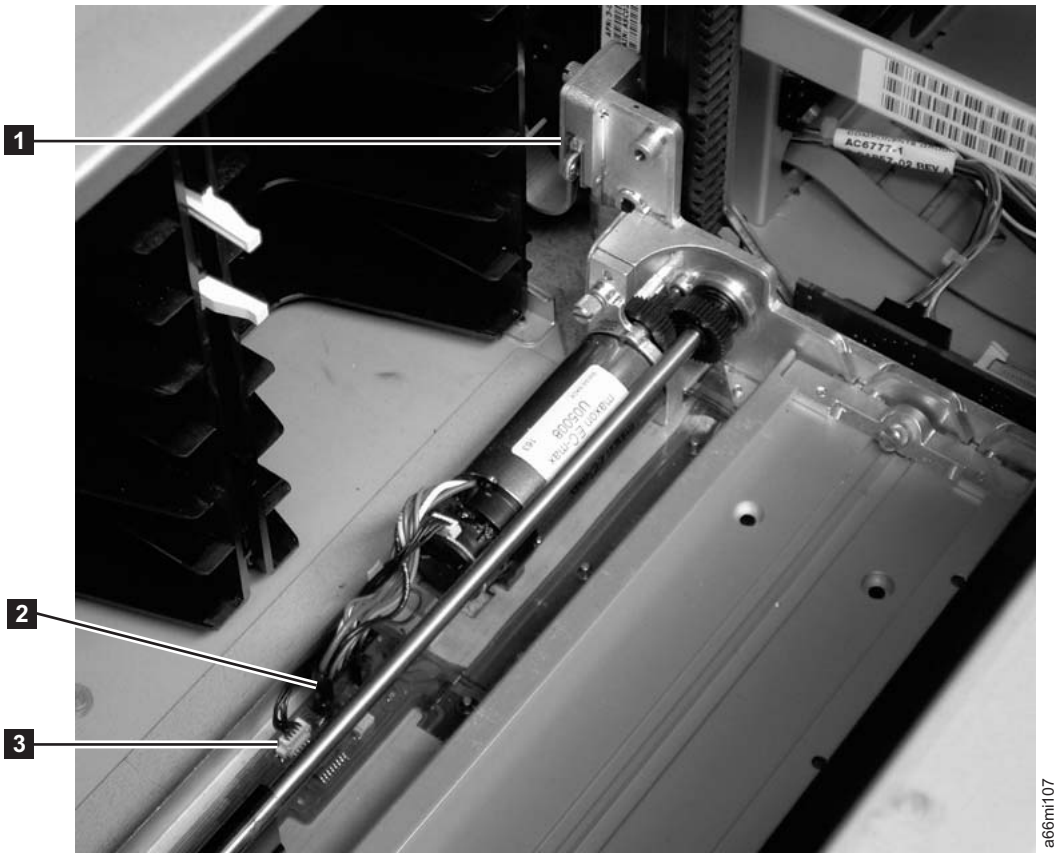


Figure 6-15. Spooler cable connector and original Y-motor assembly connectors

Table 6-7. Robot Assembly connectors

1	Spooler cable connector
2	Y-motor assembly connector
3	Y-motor assembly connector

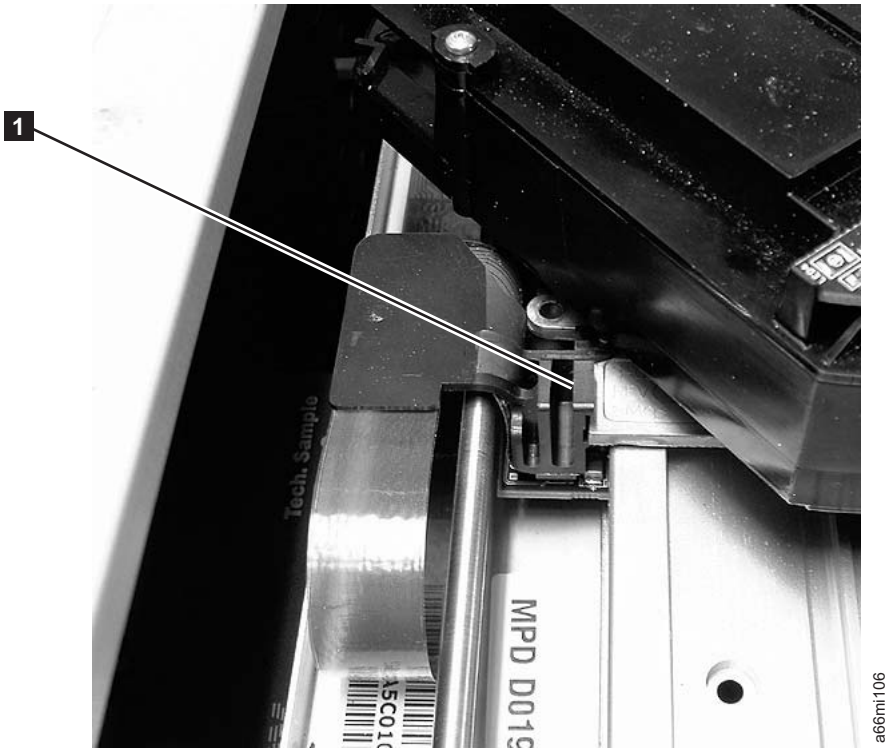


Figure 6-16. Original picker assembly connector

- For the M2 Robot Assembly, see **1**, **2**, **3**, and **4** in Figure 6-17.

Figure 6-17. Spooler cable connector and M2 Robot controller board connectors

Table 6-8. M2 Robot Assembly connectors

1	Spooler cable connector
2	Robot controller board connector
3	Robot controller board connector
4	Robot controller board connector

Taking the Drives/Library Online/Offline

Taking the drives or a library/logical library online makes it accessible to host applications via the SAN. Taking the drives or a library/logical library offline makes it inaccessible to host applications via the SAN.

Servicing some components requires only that you take the library offline, while servicing other components requires that you power OFF the entire library. For details, see "Required Library State" on page 7-2.

Taking a Drive Online

1. Using the library's Operator Panel, select **Operations > Change Drive Mode**. Using the library's Web User Interface, select **Service Library > Service Drives (Bring Online/Bring Offline)**.
2. For each drive that you want to take online click **Bring Online**.
3. Click **Apply**.

Taking a Drive Offline

1. Using the library's Operator Panel, select **Operations > Change Drive Mode**. Using the library's Web User Interface, select **Service Library > Service Drives (Bring Online/Bring Offline)**.
2. For each drive that you want to take offline, click **Bring Offline**.
3. Click **Apply**.

Taking the Library Online

1. Using the library's Operator Panel , select **Operations > Logical Library Mode**. Using the Web User Interface, select **Manage Library > Logical Libraries (Bring Online/Bring Offline)**.
2. For each logical library that you want to take online click **Bring Online**.
3. Click **Apply**.

Taking the Library Offline

1. Using the library's Operator Panel , select **Operations > Logical Library Mode**. Using the Web User Interface, select **Manage Library > Logical Libraries (Bring Online/Bring Offline)**.
2. For each logical library that you want to take offline, click **Bring Offline**.
3. Click **Apply**.

Resetting a Drive

From the Web User Interface: **Service Library** > **Reset Drives** > **Reset**

From the Operator Panel: **Tools** > **Service** > **Drives** > **Drive Tests** > **Reset** > **Select Module(s)** > **Select Drive(s)**

Some hardware or firmware failures may require a drive be reset for recovery from the failure.

Drives can be reset individually, by enclosure (module), by logical library (Web User Interface only), or by entire library.

Shutting Down/Restarting the Library

Shut down the library for servicing. Restart the library after servicing and for preparing it for use.

Shutting Down the Library

Servicing some components requires only that you take the library offline, while servicing other components requires that you power OFF the entire library. For details, see "Required Library State" on page 7-2. When library power is switched OFF, the Picker assembly slowly falls to rest at the bottom of the library.

Shutting down a library shuts down the library's operating system and firmware. When performing a shutdown, the library finishes all active commands received from the host application and does not process any new commands. It takes all logical libraries offline and lowers the robot to the "shipping" position on the floor of the library. Always perform a shutdown before removing power from the library.

Important: To completely remove all power before servicing or in an emergency, push the front power button, toggle each power supply switch to the OFF (O) position, and disconnect all power cords from their electrical source.

1. Using the library's Operator Panel, ensure that no applications are accessing the library. If a **Progress Screen** is open, wait until the operation completes.
2. Take the entire library (including all drives and logical libraries) offline.
   - To take each logical library offline using the Operator Panel, select **Operations** > **Logical Library Mode**.
   - To take each drive offline using the Operator Panel, select **Operations** > **Change Drive Mode**.
3. Shut down the library from the Operator Panel by selecting **Operations** > **Shutdown**. The **System Shutdown** window appears.
4. In the **System Shutdown** window, select **Shutdown** and click **Apply**.
5. In the **System Shutdown Confirmation** window, click **Yes**.
6. Press the power button located on the front of the control module.
7. Toggle each power supply switch to the OFF (O) position.
8. Disconnect the library's power cords from their electrical source.

Powering the Library ON

1. Connect all power cords to their electrical source.
2. Toggle the power switch on each power supply to the ON (|) position.
3. Press the power switch located on the front door of the library's control module (CM). The Operator Panel will display "Working" while the library performs the Power On Self Test (POST). The POST takes several minutes.
4. When the library is ready for operations, the login screen displays on the Operator Panel. See “Operator Panel Login Screen” on page 4-1.

Restarting the Library

1. Using the library's Operator Panel, ensure that no applications are accessing the library. If a **Progress Screen** is open, wait until it closes before attempting to restart the library.
2. Take the entire library (including all drives and logical libraries) offline.
   - To take each logical library offline using the Operator Panel, select **Operations** > **Logical Library Mode**.
   - To take each drive offline using the Operator Panel, select **Operations** > **Change Drive Mode**.
3. From the **Operations** menu, click **Shutdown**. The **System Shutdown** window appears.
4. In the **System Shutdown** window, select **Restart** and click **Apply**.
5. In the **System Restart Confirmation** window, click **Yes**.
6. Bring the entire library (including all drives and logical libraries) online.
   - Bring the desired logical libraries back online using the Operator Panel by selecting **Operations** > **Logical Library Mode**.
   - Rebooting the library brings any offline tape drives back online.

Manually Recover Cartridge from Picker

The procedure to manually recover a cartridge from a Picker is similar for both the Robot Assembly and the M2 Robot Assembly.

1. Manually rotate the Picker to gain access to the appropriate component to eject the cartridge.
   - In the Robot Assembly, access the three drive gears, as shown in Figure 6-18 on page 6-42.

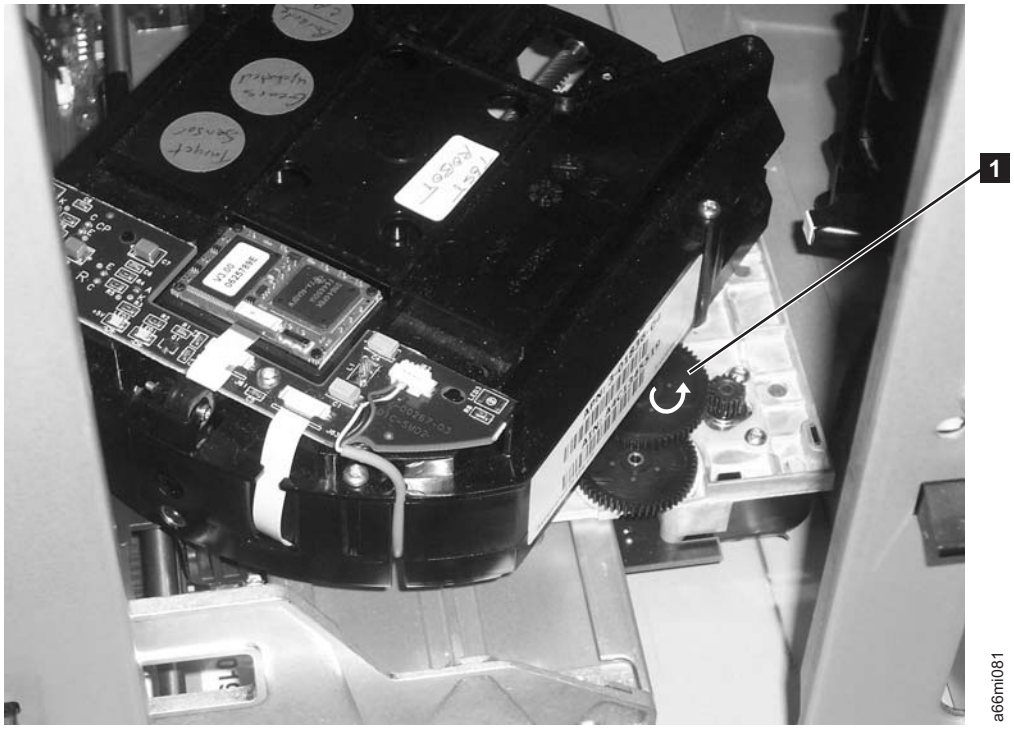


Figure 6-18. Picker rotated for drive gears access

- In the M2 Robot Assembly, access the thumbwheel on the front of the Picker as shown in Figure 6-19.

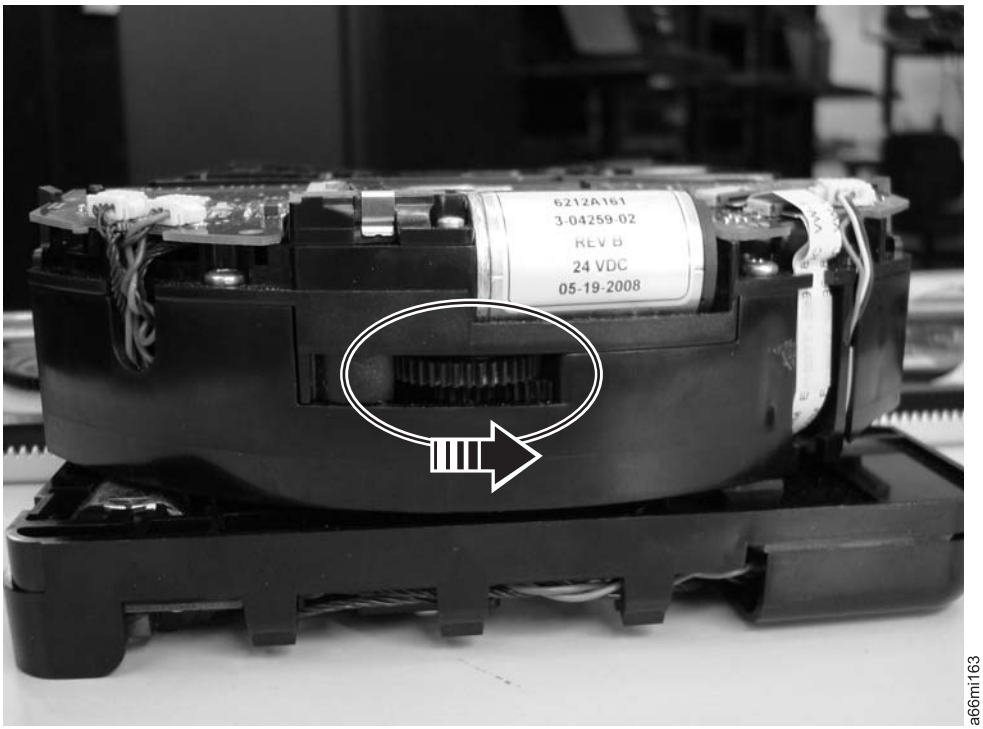


Figure 6-19. Access the M2 Picker Thumbwheel

2. Rotate the gear (**1** in Figure 6-18 on page 6-42 or the arrow in Figure 6-19 on page 6-42) with your thumb or finger, in the direction shown by the arrow.
3. Continue rotating the gear or thumbwheel until the cartridge is ejected from the picker.

Manually Unlocking the I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

There are 2 styles of I/O Station Lock mechanisms. The early style uses a T10 Torx wrench to rotate the lock mechanism. The new style has a large push-button type mechanism behind the hole (**1** in Figure 6-20) in the I/O station door.

Manually Unlocking the Early Style I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

To manually unlock the early style I/O Station lock, follow these steps:

1. Insert a T10 Torx wrench in the hole (**1** in Figure 6-20) located on the front of the I/O Station door of the library module you wish to open.
2. Turn the wrench one-quarter turn counterclockwise to unlock the door.

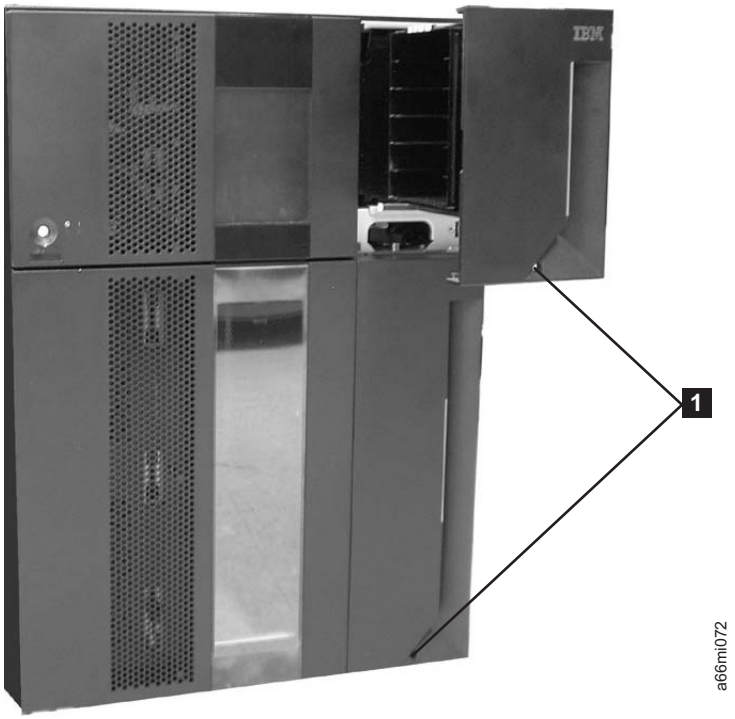


Figure 6-20. Access holes for manually unlocking I/O Station doors

3. To manually relock the I/O Station door:
   - From the Operator Panel, select **Operations** > **Lock I/O Station**
   - From the Web User Interface, select **Manage Cartridges** > **Lock/Unlock I/O Station Doors**

Manually Unlocking the New Style I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

To manually unlock the new style I/O Station lock, follow these steps:

1. Insert any straight tool (screwdriver, Torx wrench, etc.) into the hole (**1** in Figure 6-20 on page 6-43) in the front cover of the I/O station.
2. Push the tool in to unlock the I/O station door. There is a large, flat pushbutton type mechanism behind the hole in the cover that, when pushed toward the rear of the library, will release the I/O station lock mechanism.
3. To manually relock the I/O Station door:
   - From the Operator Panel, select **Operations** > **Lock I/O Station**
   - From the Web User Interface, select **Manage Cartridges** > **Lock/Unlock I/O Station Doors**

Applying a RID Tag to a Library Module

The RID (Repair Identification) Tag is important in transferring the serial number of the old library enclosure to the new library enclosure. This will ensure that your warranty coverage, if applicable, is not interrupted.

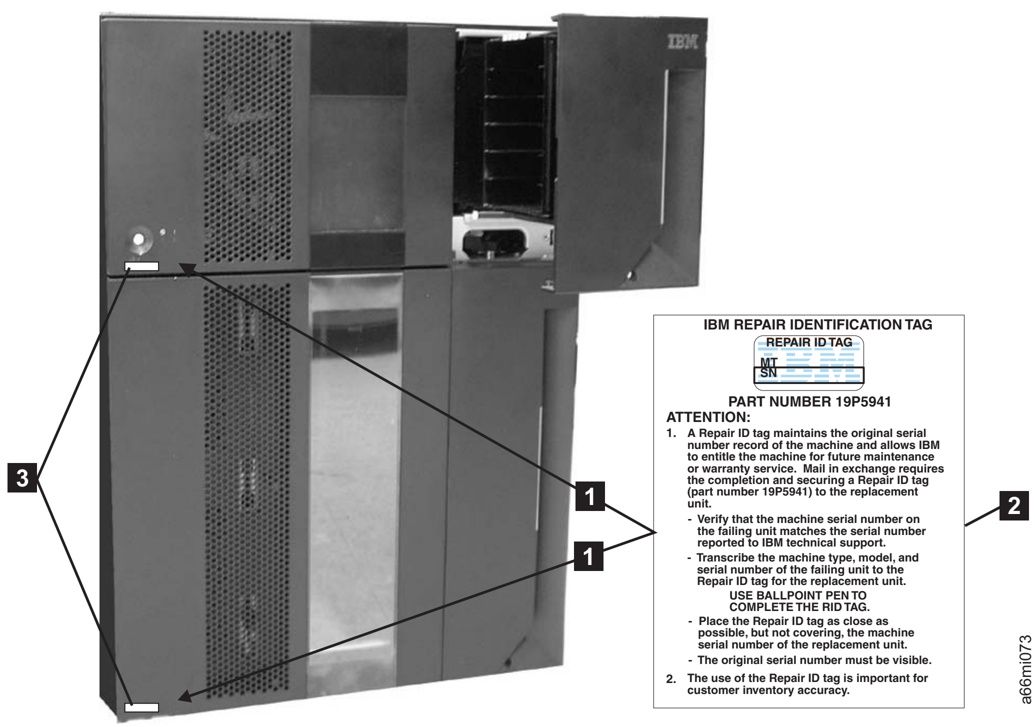


Figure 6-21. RID tag placement

1. Copy the serial number from the label in the lower left corner of the old enclosure onto the RID tag (**2** in Figure 6-21).
2. Place the RID tag to the right of, but not covering, the serial number label located in the lower left corner of the new library enclosure (**1** in Figure 6-21).

Applying an Agency Label to a Control Module

When a Control Module is replaced, an agency label must be applied to the new enclosure after it has been populated with all necessary library components.

1. On the new enclosure, open the I/O Station door, then open the Access Door.
2. Place the Agency Label (**3** in Figure 6-22) on the enclosure frame underneath the Access Door opening.

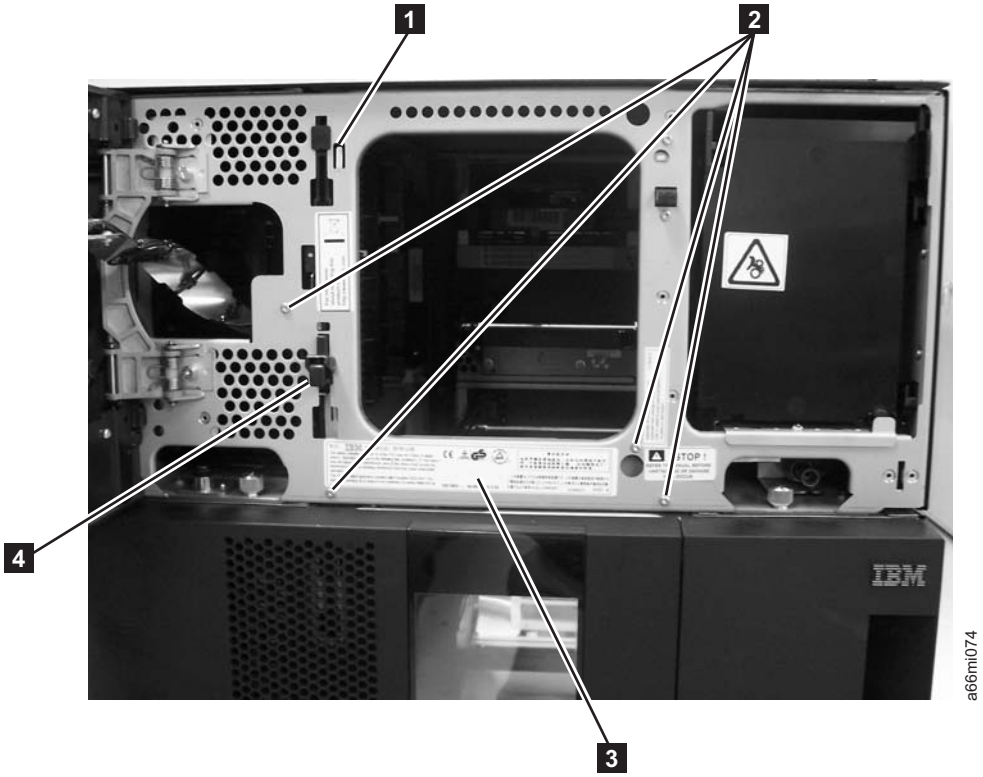


Figure 6-22. Agency Label placement

3. Close the Access Door, then close the I/O Station door.

Contacting IBM Technical Support

- Perform the steps in "Pre-Call Checklist" on page 6-46 before placing a call to IBM Technical Support.
- Prior to calling IBM Technical Support, the customer is responsible for following IBM's published LTO diagnostic procedures including any needed update to the latest level of firmware. For details, visit **http://www.ibm.com/storage/support/lto**.
- The IBM Support Center will assist with problem determination and initiate shipment of a replacement part, if needed, to the customer's location. Transportation costs, both ways, are paid by IBM. The replacement part becomes the property of the customer in exchange for the failed part, which becomes the property of IBM. The customer is responsible for packing the failed part into the shipping carton that contained the replacement part. Failure to return the failed part to IBM within 30 days will result in the customer being billed for the new

list price. The customer is responsible for installing and setting up the CRU replacement part. All FRU replacement parts will be installed by an authorized IBM Service Representative.

- Failure to use the carton in which the replacement part was received, or failure to otherwise properly pack the returned part, could result in charges being incurred by the customer for damage to the failed part during shipment.
- Before calling support, follow these steps which will help you take full advantage of your call:
  1. Be prepared to provide library and drive firmware levels currently installed.
  2. Review all documentation carefully. (Experience has demonstrated that most questions are answered in your documentation.)
  3. Be prepared to explain whether the software or hardware has worked properly at anytime in the past. Have you changed anything recently?
  4. Pinpoint the exact location of your problem, if possible. Note the steps that led to the problem. Can you duplicate the problem or is it a one-time occurrence?
  5. Note any error messages displayed. Write down the exact error message.
  6. If at all possible, call while at your computer, with the library installed and turned ON.
  7. If running on a network, have all relevant information available (that is, type, version number, network hardware, and so on).
  8. Be prepared to provide:
     - Machine type and Model name(s)
     - Serial number of the library (front of the control module on the label underneath the power button)
     - Software version numbers
     - Device driver information
     - Host application name and version
     - Hardware configuration, including firmware versions, date, and number
     - Type of host, operating system version, clock speed, RAM, network type, network version, and any special boards installed
     - A brief description of the problem, including Service Action Ticket number (Txxx).

     Having this information available when you call for customer assistance will enable support personnel to resolve your problem in the most efficient manner possible.
- To contact IBM Technical Support:
  - In the USA: 1-800-IBM_SERV (1-800-426-7378)
  - All other Countries/Regions: **http://www.ibm.com/planetwide/**
  - To open a Service Request online: Under **Get Support**, click **Open a Service Request**.

Pre-Call Checklist

If you have questions or problems concerning the library, perform the following steps before placing a call to IBM Technical Support.

Note: Where instructions refer you to the web, visit **http://www.ibm.com/storage/support/lto**.

1. Verify that you have exhausted all troubleshooting options (refer to Chapter 1, “Start Service,” on page 1-1.
2. Verify that the drive’s firmware is at the most recent level (see “Viewing Drive Information”). To determine the latest release of firmware, visit the web.
3. Verify that your device drivers are at the most recent level (see your server (host) manual for instructions).
   - For the latest release of IBM device drivers, visit the web.
   - For the latest release of device drivers by Independent Software Vendors (ISVs), visit the appropriate third-party web site.
4. Verify whether your hardware and software configuration is supported. To determine the latest supported attachments, visit the web.
5. Perform a general checkup of the hardware and connections:
   - Ensure that the host interface cable connector does not contain bent or recessed pins.
   - Ensure that all retention screws for the host interface cable and terminator are securely tightened.
   - For SCSI attached systems, ensure that you are using the correct SCSI terminator and that you are not mistakenly using a SCSI wrap plug.
6. If you still have a problem after completing the above steps, see “Contacting IBM Technical Support” on page 6-45.

Viewing Drive Information

From the Operator Panel: **Tools** > **Drive Info**

From the Web User Interface: **Monitor System** > **Library Map** Position cursor over drive. Left-click to see drive information

This menu item provides the following information for each drive:

- Drive location
- Control path (Yes or No)
- Vendor ID
- Model number
- Type
- Serial number
- Drive firmware level
- Sled boot version
- Sled app version
- Status
- Loaded (yes or no)
- SCSI ID/WWNN/SAS address

End of Call

1. If any cartridges were removed from the library, give them to the customer.
2. Record your activity in Chapter 8, “History of Service Activity,” on page 8-1.
3. Return control of the library to the customer.

CAN Bus Tool Kit

The CAN Bus Tool Kit includes a Floor Plate (see Figure 1. The Floor Plate). The Floor Plate is used to isolate CAN Bus problems without removing the library bottom-plate or removing L5B/E9U library modules.

The Floor Plate from the CAN Bus Tool Kit is installed as a temporary bottom-plate in the library. Since the Floor Plate has the y-axis home flag mounted on it, the library will be able to boot up properly. When the Floor Plate is installed and the CAN Bus terminators reconfigured, the library modules below the Floor Plate are not included in the library configuration. The library modules above the control module can be eliminated by moving the CAN Bus terminator appropriately.

The CAN Bus Tool Kit can be used to troubleshoot the following types of errors:

- No green LED on top of the picker and no picker motion
- Service Action Tickets – T013, T021, T024, T025, T030, T060, T062, T076, T096

The CAN Bus Tool is intended for use only by trained technical personnel familiar with 3576 library operation. It is critical to configure the library CAN Bus correctly when using the CAN Bus Tool. Instructions for using the CAN Bus Tool are included in the CAN Bus Debug Tool Kit. The part number for the CAN Bus Debug Tool Kit is listed in Chapter 9, “Parts List,” on page 9-1.

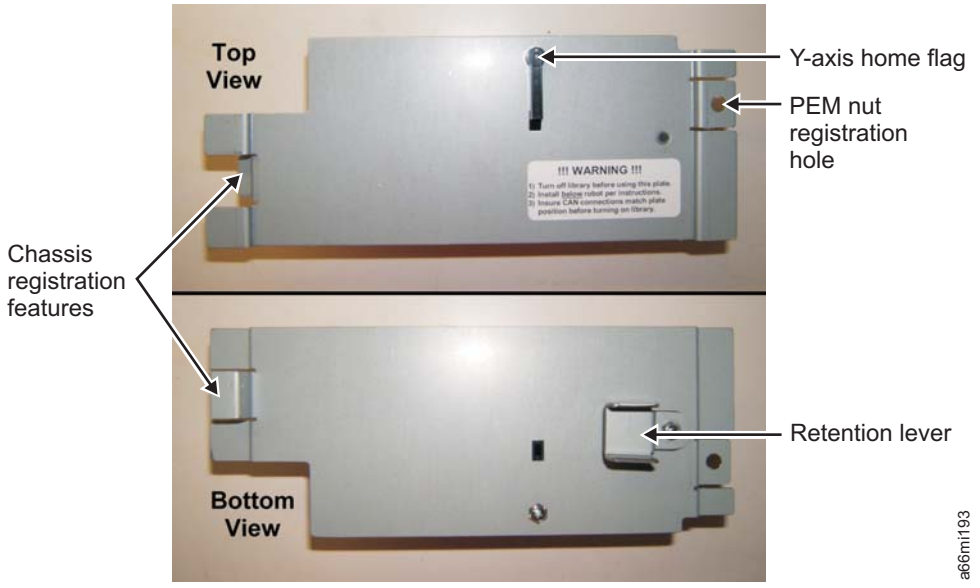


Figure 6-23. The Floor Plate

Chapter 7. Check, Adjust, Remove and Replace Procedures

Before you begin servicing the library, refer to "General Service Guidelines" on page 6-3.

CRUs and FRUs

All electrical and non-static mechanical components of the 3576 Tape Library are either customer replaceable units (CRU) or field replaceable units (FRU). A CRU is a component that customers can remove or replace themselves, whereas a FRU is a component that only service personnel should remove or replace.

When servicing a FRU, you may also need to service a CRU. Therefore, all CRUs and FRUs for the library are itemized in the following table.

Table 7-1. Library FRUs and CRUs

Part Name	CRU/FRU	Reference Information
Cable Spool	FRU	"Cable Spool Assembly" on page 7-110
Control Module enclosure	FRU	"Removing/Replacing a Control Module" on page 7-4
Expansion Module enclosure	FRU	"Installing a Replacement Expansion Module Enclosure" on page 7-19
Front Bezels	FRU	"Bezels" on page 7-25
I/O Station Lock Assembly	FRU	"I/O Station" on page 7-32
I/O Station Safety Flap	FRU	"I/O Station" on page 7-32
Operator Panel	FRU	"Operator Panel" on page 7-27
Picker Assembly	FRU	"Original Picker Assembly" on page 7-58 "M2 Picker Assembly" on page 7-82
Power Switch/LED Board	FRU	"Removing the Power Switch/LED Board Assembly" on page 7-31
Storage Column	FRU	"Removing/Replacing a Storage Column" on page 7-106
Y-axis Assembly	FRU	"Y-axis/Picker Assembly" on page 7-54 "M2 Robot Assembly" on page 7-77
Y Motor	FRU	"Y Motor" on page 7-60
Compact Flash (CF) Card	CRU	"Library Control Blade or Compact Flash Card" on page 7-44
Library Control Blade (LCB)	CRU	"Library Control Blade or Compact Flash Card" on page 7-44
Power Supply	CRU	"Power Supply (Primary and Redundant)" on page 7-51
Rack Mount Kit	CRU	Refer to the *Setup and Operator Guide*.
Tape Drive Sled	CRU	"Drive Sled" on page 7-42

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Required Library State

Adding, removing, and replacing library components usually requires you to power OFF the entire library. There are a few components, however, that you can service without powering OFF the library. Instead, you may need only to take a certain logical library OFFLINE or you may not need to impact the status of the library at all.

Use the following table to determine the state that the library must be in before you service each part.

Table 7-2. Servicing library components: Library state required

Part	Required Library Status
Cable spool	Power OFF
Control module	Power OFF
Drive power fuse	Power OFF
Expansion module	Power OFF
Gear rack	Power OFF
Front bezels	Take library offline
I/O Station lock assembly	Power OFF
I/O Station slide/magazine assembly	Take library offline
I/O Station safety flap	Power OFF
LCB/CF	Power OFF
Operator panel	Power OFF
Picker assembly	Power OFF
Power switch/LED board	Power OFF
Power supply, primary	Power OFF
Power supply, redundant	Power ON/Normal
Storage column	Power OFF
Tape drive sled	Power ON
Y-axis assembly	Power OFF
Y motor	Power OFF

Required Tools

Servicing the library requires the following tools:

- T10 TORX screwdriver with a static safe handle
- #1 and #2 Philips screwdrivers
- small flat blade screwdriver
- Electrostatic Discharge (ESD) Kit (P/N 93F2649)
- safety glasses

Electrostatic Discharge

Important: A discharge of static electricity can damage static-sensitive devices or microcircuitry. Proper packaging and grounding techniques are necessary precautions to prevent damage.

To prevent electrostatic damage, observe the following precautions:

- Transport products in static-safe containers such as conductive tubes, bags, or boxes.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free stations.
- Cover the unit with approved static-dissipating material. If available, provide a ground strap connected to the work surface and properly grounded tools and equipment. If a ground strap is not available, touch a metal surface to discharge any static electricity in your body.
- Keep the work area free of non-conducting materials, such as ordinary plastic assembly aids and foam packing.
- Make sure you are always properly grounded when touching a static-sensitive component or assembly.
- Avoid touching pins, wires, or circuitry.
- Use conductive field service tools.

Preparing a Library or Library Module for Repairs

1. Ensure all drives are empty.
2. Power OFF the library.
   - If the library is idle:
     a. Press the power button on the front panel of the control module.
     b. Toggle each power supply switch to the OFF (O) position.
   - If the library is processing:
     a. From the Operator Panel, select **Operations** > **Shutdown** to end the current library task and shut down the library's operating system.
     b. When the library becomes idle, press the power button on the front panel of the control module.
     c. Toggle each power supply switch to the OFF (O) position.

Returning a Library or Library Module to Normal Operations after Repairs

1. Power ON the library.
   a. Toggle each power supply switch to the ON (|) position.
   b. Press the power button on the front of the library.
2. If necessary, have the customer replace all tape cartridges in library or library module.
3. If necessary, vary drives and logical libraries online.

Removing/Replacing a Control Module

The Control Module enclosure (chassis) is not available as a FRU. If the Service Action Ticket (T code) or Diagnostic Resolution Procedure specifies replacement of the enclosure, it will be necessary to replace the Internal Cables and Boards Kit instead.

To make repairs to a control module, choose and perform one of these procedures:

- "Removing a 5U Library (Control Module) from a Rack"
- "Replacing a 5U Library (Control Module) in a Rack"
- "Removing a Control Module from a Standalone or Rack-mounted Library (14U or larger)" on page 7-5
- "Replacing a Control Module in a Standalone or Rack-mounted Library (14U or larger)" on page 7-11

Removing a 5U Library (Control Module) from a Rack

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Unplug the customer-supplied Ethernet cable from the Library Control Blade (**2** in Figure 7-49 on page 7-46).
3. Remove these components from the control module to reduce the weight of the module.
   a. Power supplies (see "Power Supply (Primary and Redundant)" on page 7-51)
   b. Drive sleds (see "Drive Sled" on page 7-42)
4. Loosen the thumb screws securing the library to the rear flange on each Rack Kit rail.
5. Open the I/O Station door then the Access door on the control module.
6. From the front of the control module, remove the rack ears (see "Removing the Rack Ears" on page 7-19).
7. With a person standing on each side of the library, pull the control module out of the rack.
8. Place the library on a sturdy work surface.

Replacing a 5U Library (Control Module) in a Rack

1. With a person on each side of the library, pick it up from the work surface and slide it onto the Rack Kit rails in your rack.
2. Tighten the thumb screws that secure the library to the rear flange of each Rack Kit rail.
3. Install the rack ears on the front of the library to secure it to the rack (see "Replacing the Rack Ears" on page 7-20.
4. Reconnect the customer-supplied Ethernet cable to the Library Control Blade (**2** in Figure 7-49 on page 7-46).
5. Reinstall the following components removed for weight reduction.
   a. Drive sleds (see "Drive Sled" on page 7-42)
   b. Power supplies (see "Power Supply (Primary and Redundant)" on page 7-51)
6. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing a Control Module from a Standalone or Rack-mounted Library (14U or larger)

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.

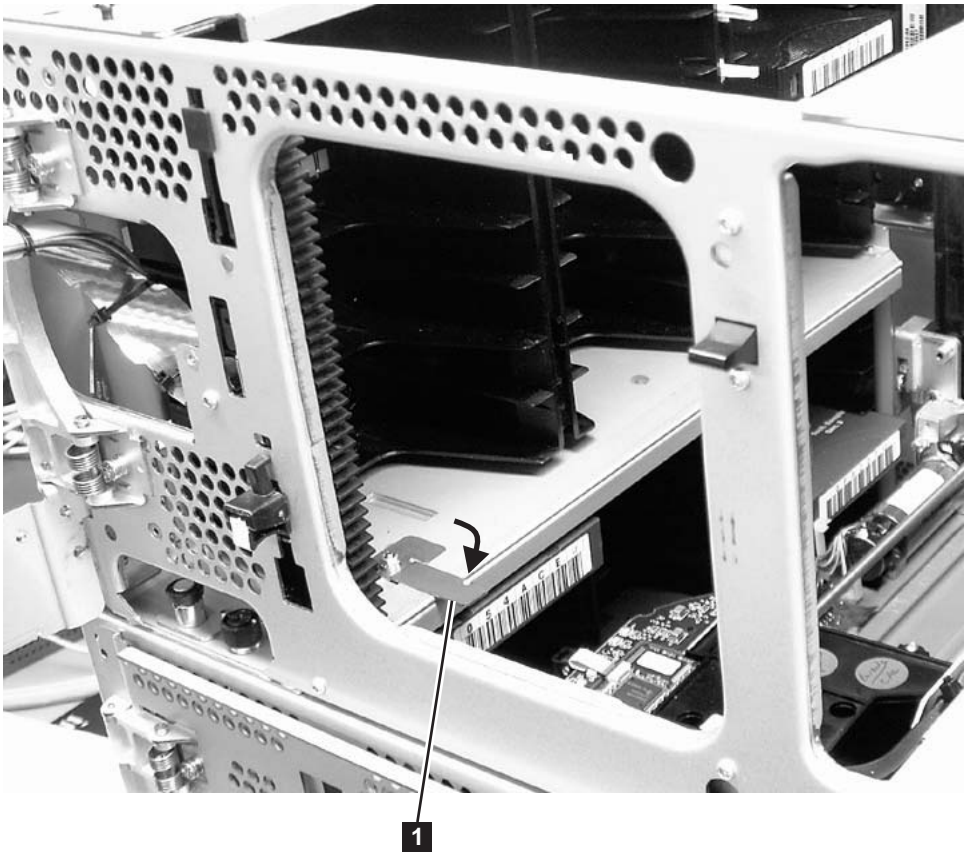

Figure 7-1. Picker locking mechanism

2. Move the Picker into the control module.
   a. Gently push the Picker up until it is in the control module.
   b. Engage the Picker locking mechanism (**1** in Figure 7-1).

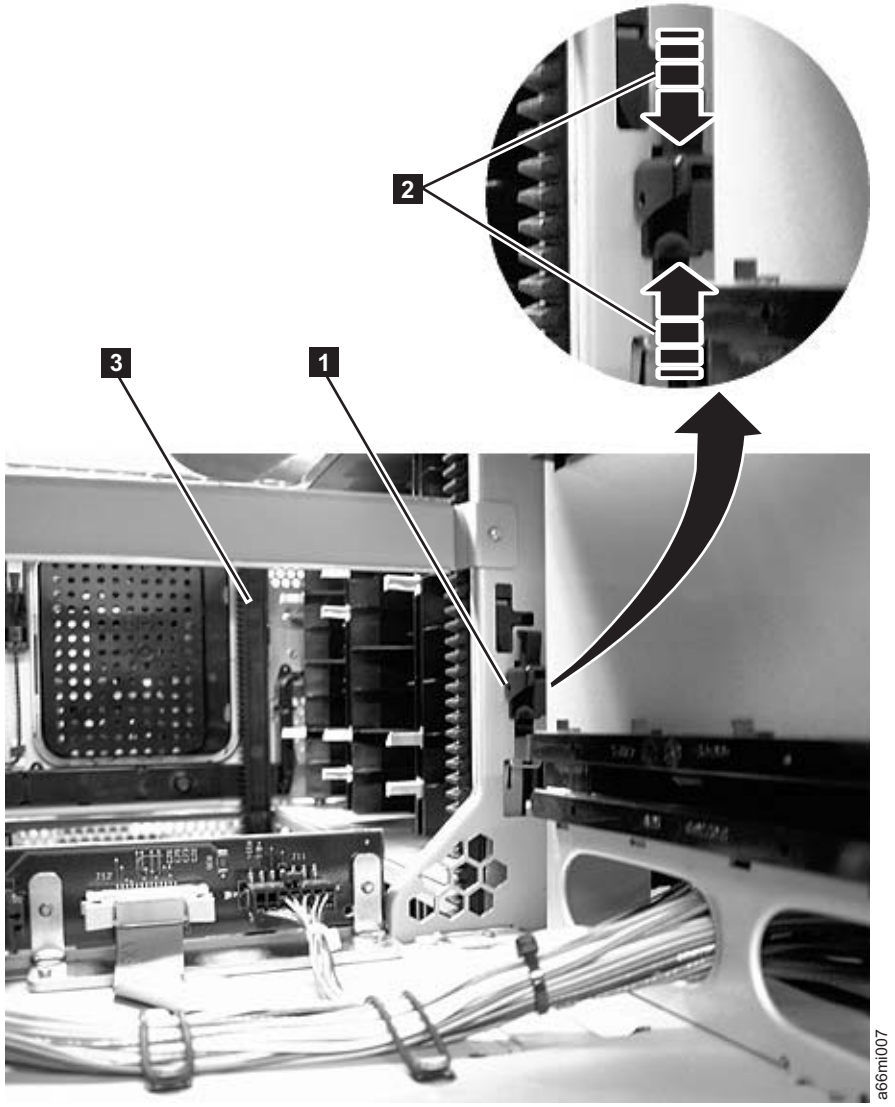

Figure 7-2. Gear racks and gear rack locking mechanism

3. Disengage the rear (**1** in Figure 7-2) and front (**3** in Figure 7-2) gear racks in the control module. While pinching the gear rack locking mechanism (**2** in Figure 7-2), push the gear rack up until it locks in place. To release the gear rack and move it up, perform the following steps.

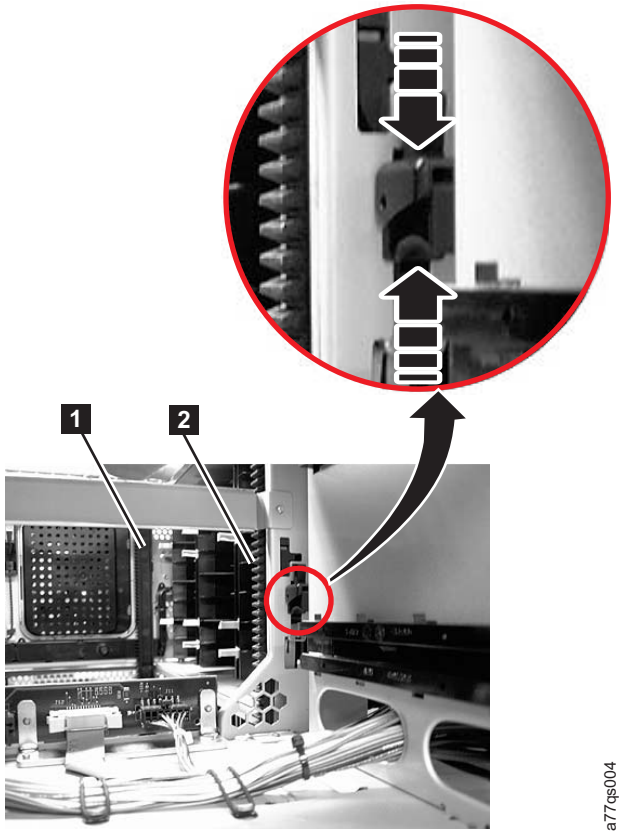

Figure 7-3. Front and back gear racks

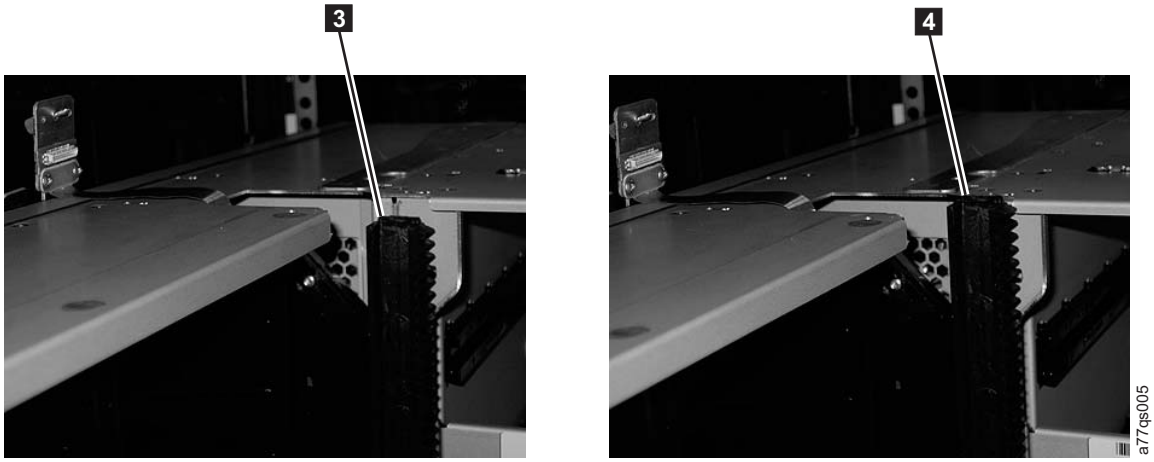

Figure 7-4. Gear racks in the up and down positions

a. Disengage the Y-rails so the module can be unstacked safely.

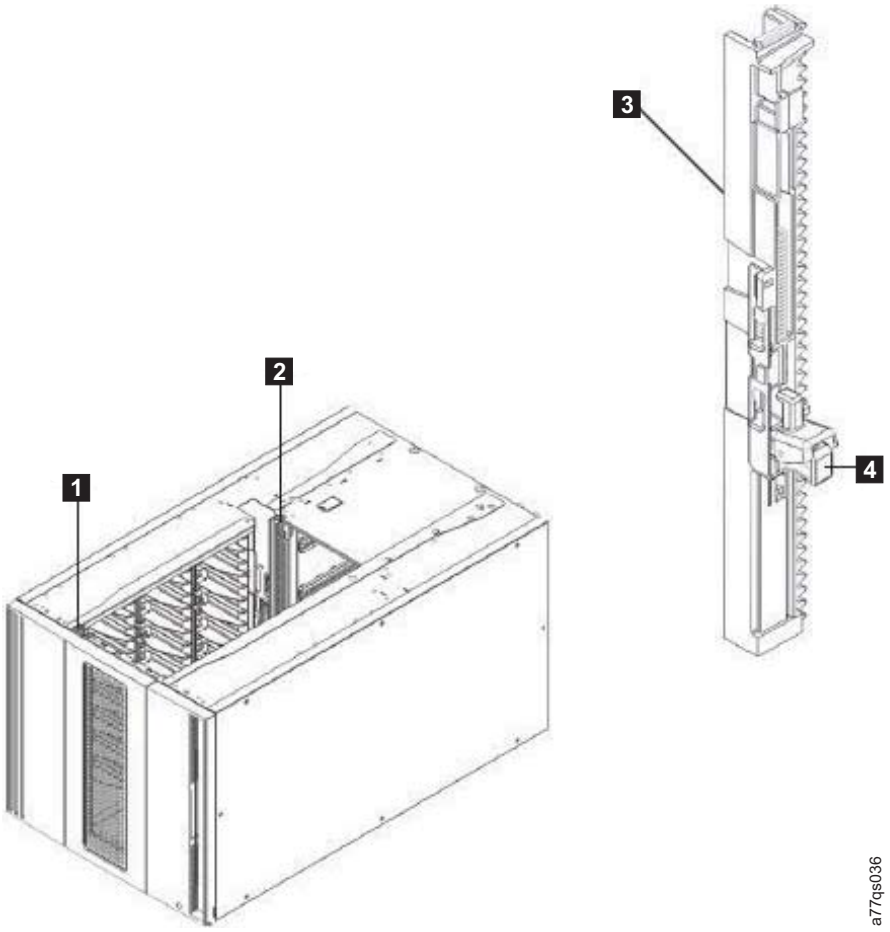

Figure 7-5. Placing gear rack in Up position

1	Front Y-rail	3	Y-rail (this end up)
2	Rear Y-rail	4	Squeeze here to release

b. From the front of the library, find the Y-rail release mechanism, which is located on the left side of the control module. Squeeze the handle of the Y-rail release mechanism, lift it, and release it so it locks in place.

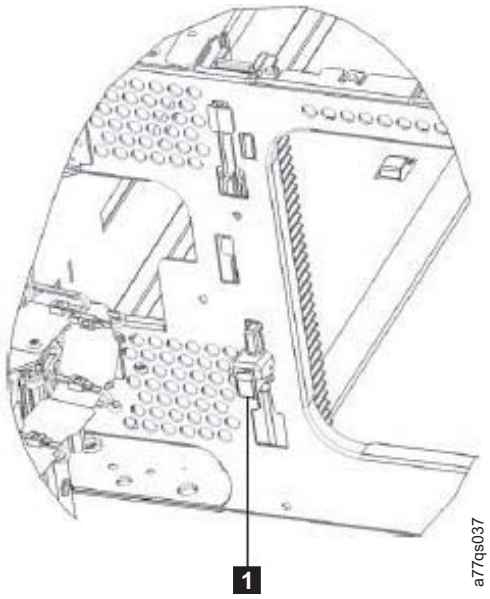

Figure 7-6. Releasing the Y-rail

1	Y-rail in unlocked, functional position

c. From the rear of the library, find the rear Y-rail release mechanism located in the interior of the right side of the module. Squeeze the handle of the Y-rail release mechanism, lift it, and release it so that it locks in place.

4. Unplug the customer-supplied Ethernet cable from the Library Control Blade (2 in Figure 7-49 on page 7-46).
5. Unplug the module-to-module communication cable from the control module (4 in Figure 7-49 on page 7-46).
6. Remove the following components from the control module to reduce the weight of the module.
   a. Power supplies (see "Power Supply (Primary and Redundant)" on page 7-51).
   b. Drive sleds (see "Drive Sled" on page 7-42).

   Note: If not already done, have the customer remove all tape cartridges from the module being removed.

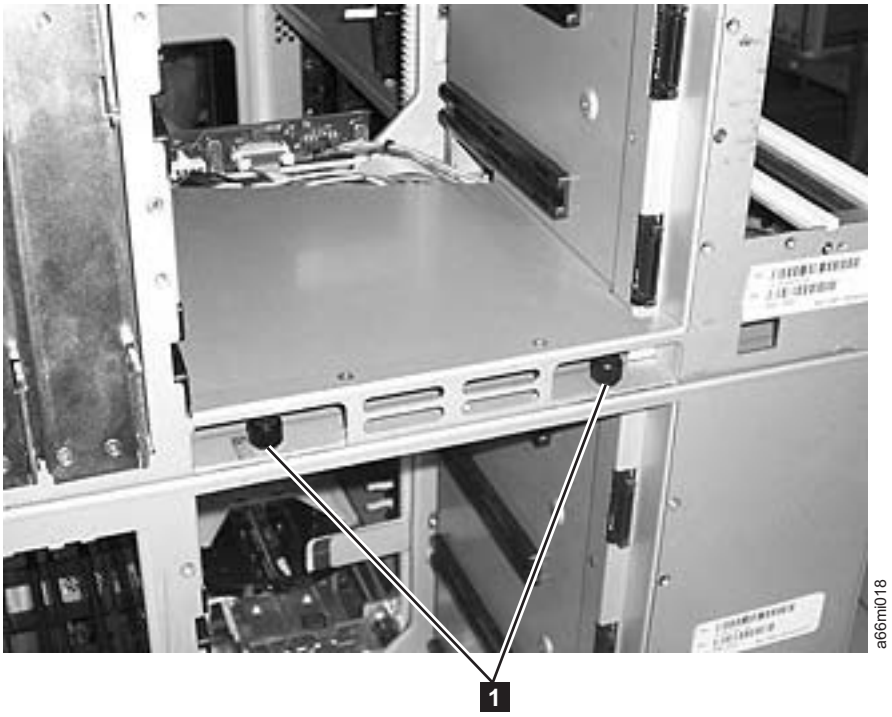

Figure 7-7. Control module rear thumb screws

7. Loosen the rear thumb screws (**1** in Figure 7-7) securing the control module to the lower expansion module.
8. If your library is installed in a rack, remove the rack ears (see "Removing the Rack Ears" on page 7-19) from the front of the control module.

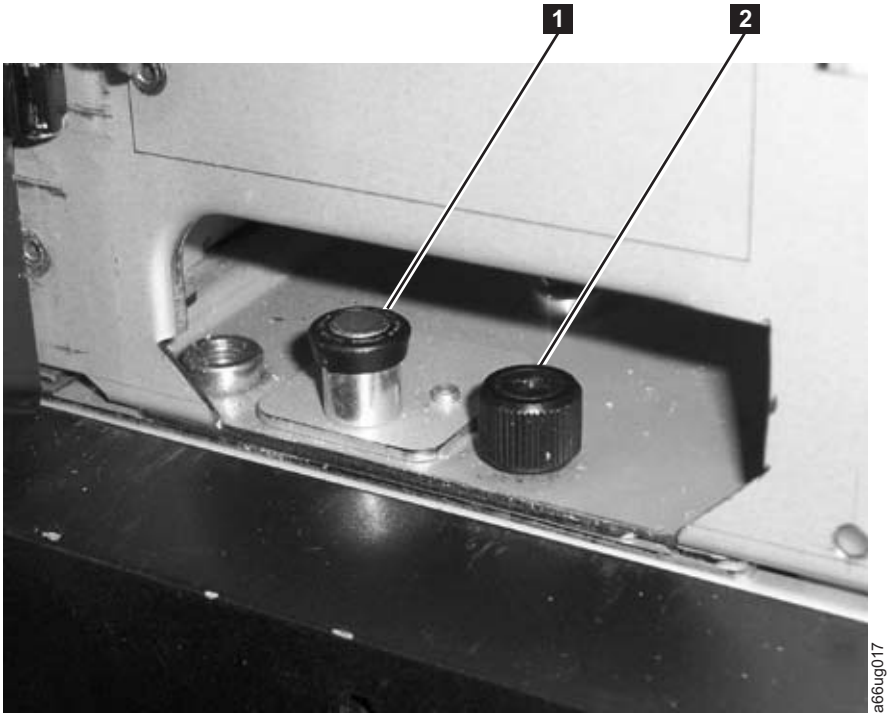

Figure 7-8. Alignment pin and front thumb screw

9. Open the I/O Station door, then open the Access Door of the control module to expose the control module alignment pin (1 in Figure 7-8 on page 7-10) and front thumb screws (2 in Figure 7-8 on page 7-10) behind the Access Door and behind the I/O Station door.
10. Loosen the front thumb screws.
11. Lift and rotate the control module alignment pin to lock the pin in an up position.
12. With a person standing on each side of the control module, pull it out of the rack.
13. Place the control module on a sturdy work surface.

Replacing a Control Module in a Standalone or Rack-mounted Library (14U or larger)

1. Ensure that the front and rear gear racks are in the upper position (see 2 in Figure 7-9).

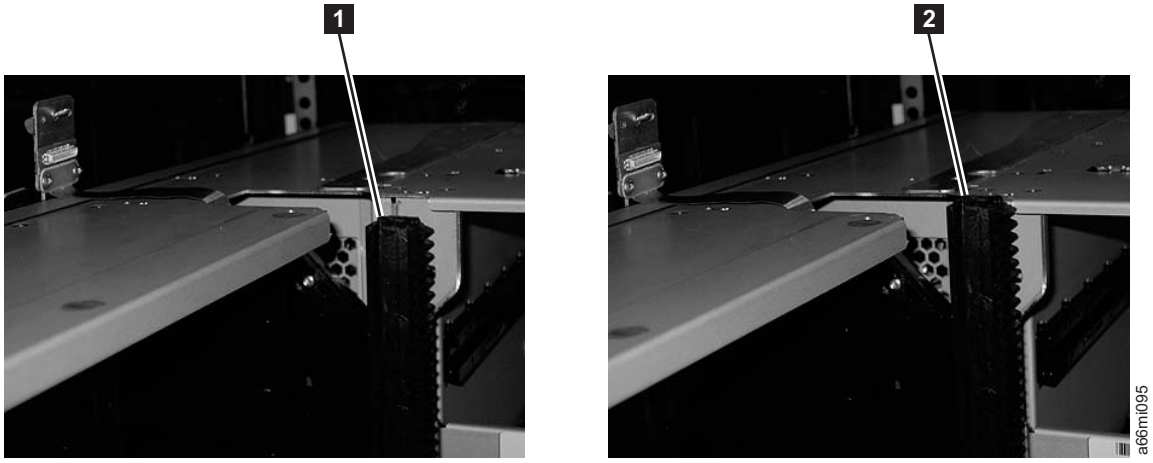

Figure 7-9. Gear racks (down and up)

2. Ensure that the module-to-module alignment pin (1 in Figure 7-8 on page 7-10) is in the raised position. If necessary, raise the pin and rotate it half a turn to lock it in the raised position.
3. With a person on each side of the control module, pick the control module up from the work surface and slide it partway onto the expansion module in the rack using the guide slots on the top of the expansion module and the bottom of the control module.

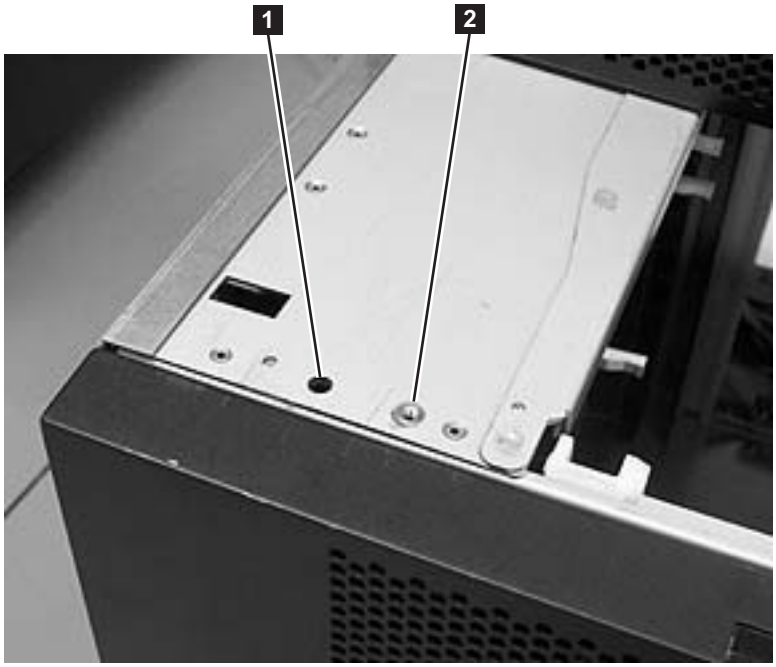

Figure 7-10. Alignment pin and front thumb screw receptacles

4. Open the I/O Station door, then open the Access Door of the control module to expose the control module alignment pin behind the Access Door.
5. Push the control module onto the lower expansion module.
6. Twist the control module alignment pin (**1** in Figure 7-8 on page 7-10) to unlock it from the up position.
7. Adjust the control module's position on top of the expansion module until the control module alignment pin drops into the alignment pin receptacle (**1** in Figure 7-10) in the lower expansion module.
8. Tighten the front thumb screw (**2** in Figure 7-8 on page 7-10) to secure the front of the control module to the lower expansion module (**2** in Figure 7-10).
9. Open the I/O Station door and tighten the other front thumb screw.

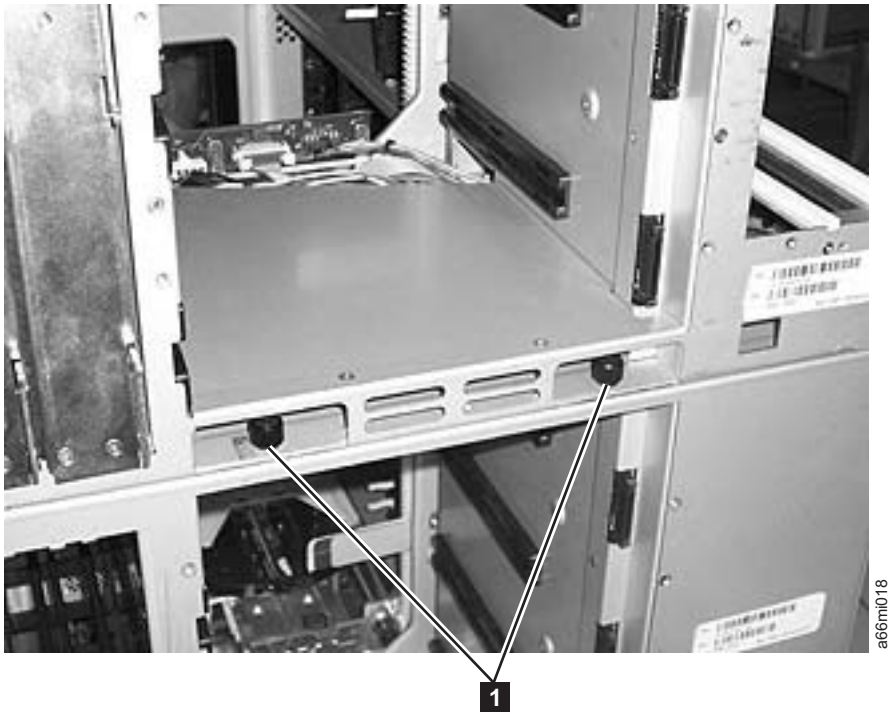

Figure 7-11. Control module rear thumb screws

10. Tighten the rear thumb screws (**1** in Figure 7-11) that secure the control module to the lower expansion module.
11. If your library is installed in a rack, reinstall the rack ears on the front of the control module to secure it to the rack (see "Replacing the Rack Ears" on page 7-20).

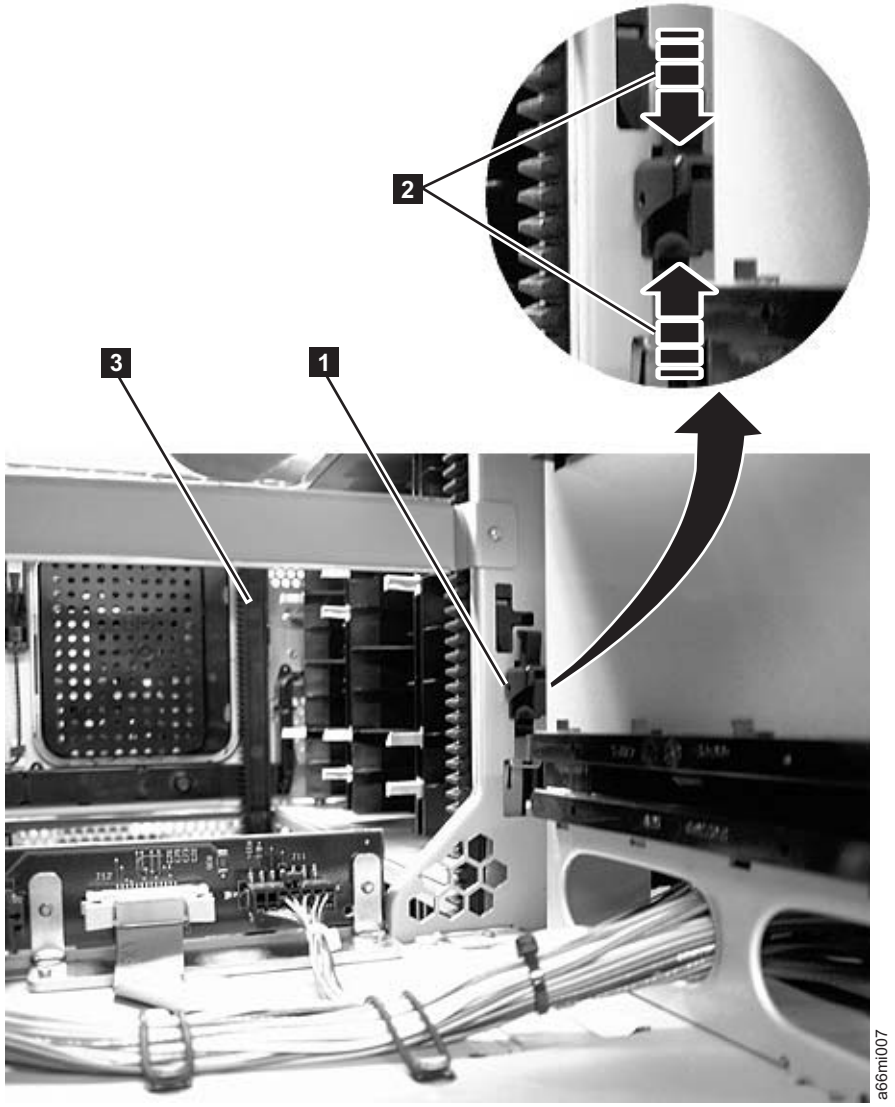

Figure 7-12. Gear racks and gear rack locking mechanism

Important: If the Control Module is at the bottom of the library, the gear racks should remain locked in the UP position. Skip step 12 and step 13 if the Control Module is at the bottom of the library. If the Control Module is not at the bottom of the library, perform step 12 and step 13.

12. Engage the rear (**1** in Figure 7-12) and front (**3** in Figure 7-12) gear racks in the control module. While pinching the gear rack locking mechanism (**2** in Figure 7-12), push the gear rack down until it locks in place and no gaps appear between the front and rear gear racks in the control module and expansion module.
13. To release the gear rack and move it down, follow these steps.
    - Engage the Y-rails of each module in your library configuration. Ensure that the Y-rails are properly aligned and the thumbscrews are tightened.

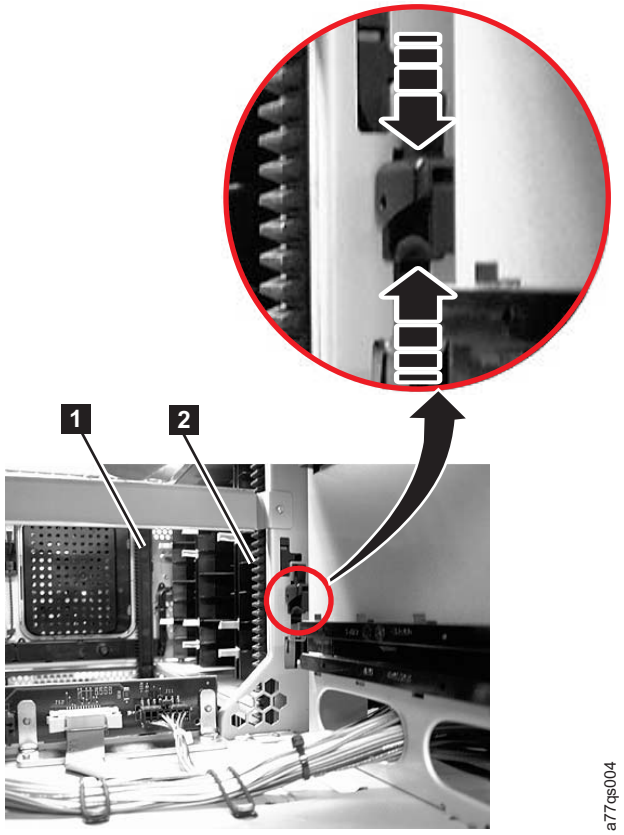

Figure 7-13. Front and back gear racks

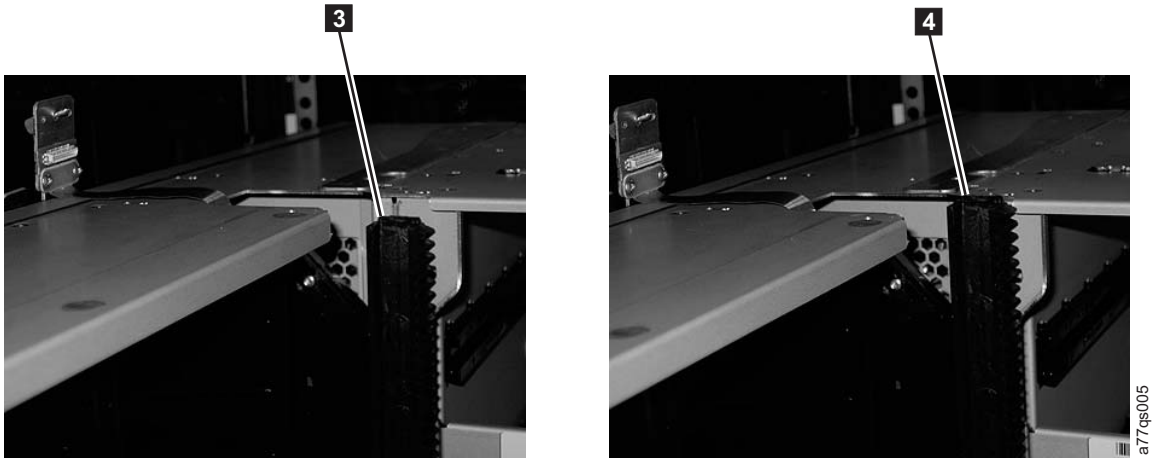

Figure 7-14. Gear racks in the up and down positions

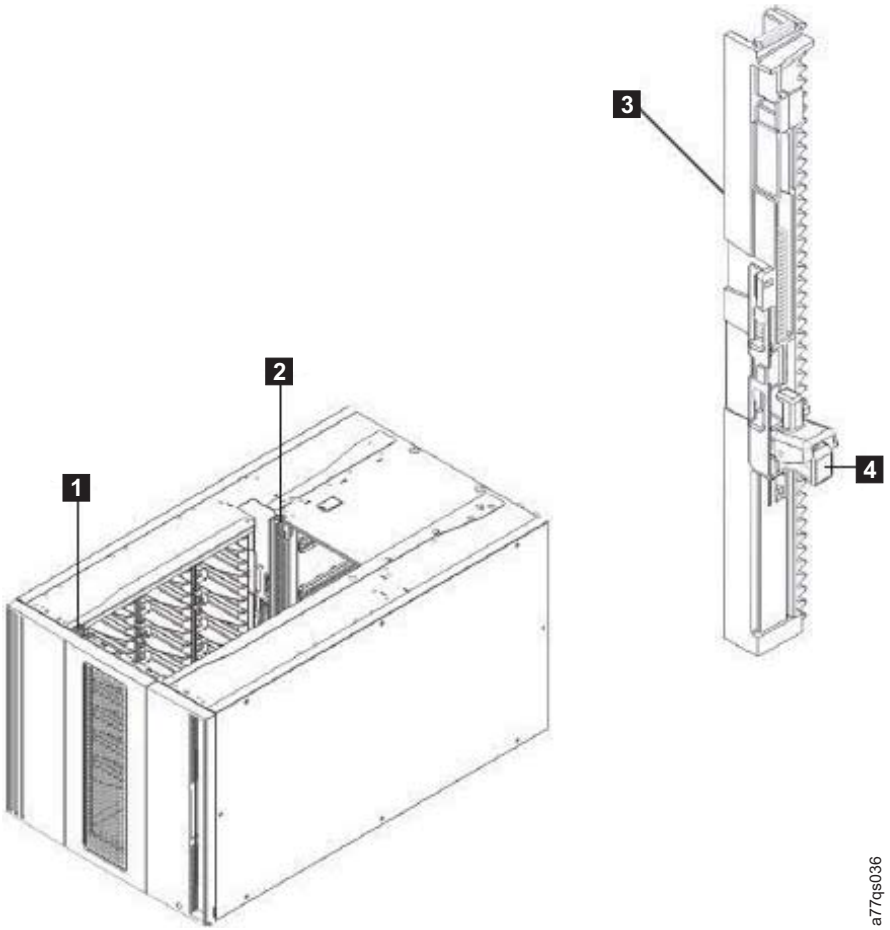

Figure 7-15. Placing gear rack in the Down position

1	Front Y-rail	3	Y-rail (this end up)
2	Rear Y-rail	4	Squeeze here to release

- From the front of the library, open the I/O station and access door of the 9U expansion module. Squeeze the handle of the Y-rail release mechanism, lift it out of its locked position, and slide it downward as far as it will go.

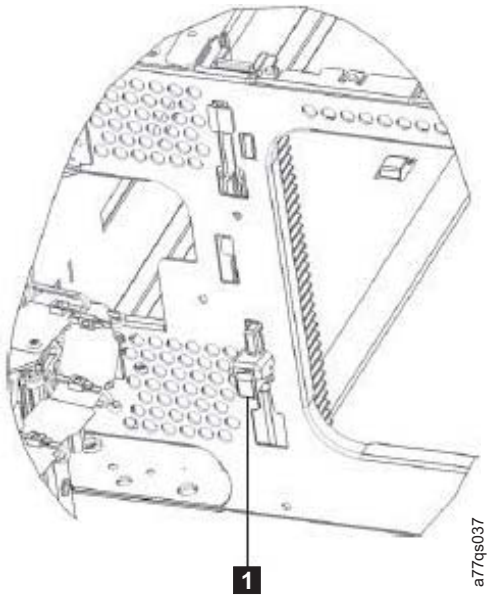

Figure 7-16. Releasing the Y-rail

1 Y-rail in unlocked, functional position

- From the back of the library, find the rear Y-rail release mechanism, which is located in the interior of the right side of the module. Squeeze the handle of the Y-rail release mechanism, lift it out of its locked position, and slide it downward as far as it will go. Doing this aligns the Y-rails with the Y-rails of the module beneath it.

  CAUTION:
  Ensure that there is no gap between the top and bottom Y-rails on both the front and back of the library. If a gap exists, the library cannot mechanically initialize.

14. Gently push the Picker assembly up high enough to release the Picker locking mechanism (see **1** in Figure 7-1 on page 7-5).
15. Release the Picker assembly and allow it to slowly drop to the bottom of the library.
16. Reinstall all control module components removed for weight reduction.
    a. Drive sleds (see "Drive Sled" on page 7-42)
    b. Power supplies (see "Power Supply (Primary and Redundant)" on page 7-51)
17. Reconnect the customer-supplied Ethernet cable to the Library Control Blade (for cable location, see **2** in Figure 7-49 on page 7-46).
18. Reconnect the module-to-module communication cable from the control module to the expansion module (**4** in Figure 7-49 on page 7-46).
19. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing/Replacing an Expansion Module

An expansion module increases the number of drives and data cartridge storage slots available within your library.

To make repairs to an expansion module, perform one of the following procedures.

- "Removing an Expansion Module from a Library"
- "Replacing an Expansion Module in a Standalone or Rack-mounted Library (14U or larger)"

To install a replacement expansion module, perform the following procedure.

- "Installing a Replacement Expansion Module Enclosure" on page 7-19

Removing an Expansion Module from a Library

1. Remove the following components from the expansion module for weight reduction:
   a. All power supplies (see "Power Supply (Primary and Redundant)" on page 7-51)
   b. All drive sleds (see "Drive Sled" on page 7-42)

   Note: If not already done, have the customer remove all tape cartridges from the module being removed.
2. Loosen the thumb screws securing the expansion module to the rear flange on each Rack Kit rail, or to the module below.
3. Open the I/O Station door then the Access door on the expansion module.
4. From the front of the expansion module, remove the rack ears (see "Removing the Rack Ears" on page 7-19).
5. Raise the gear racks (Refer to Figure 7-12 on page 7-14).
6. Raise the locating pin. (Refer to Figure 7-8 on page 7-10).
7. Loosen the thumb screw in the front.
8. Disconnect the module to module cables.
9. With a person on each side of the expansion module and a person in front of the expansion module, pull the module out of the rack.
10. Place the module on a sturdy work surface.

Replacing an Expansion Module in a Standalone or Rack-mounted Library (14U or larger)

1. If your library is to be reinstalled into a rack, perform the following:
   a. With a person on each side of the expansion module and one person in front of the expansion module, pick the module up from the work surface and slide it onto the Rack Kit rails installed in your rack.
   b. Lower the locating pin. (Refer to Figure 7-8 on page 7-10).
   c. Tighten the front thumb screws.
   d. Lower the gear racks. (Refer to Figure 7-12 on page 7-14).

   Important: If the Expansion Module is at the bottom of the library, the gear racks should remain locked in the UP position. Skip step d. if the Expansion Module is at the bottom of the library. If the Expansion Module is not at the bottom of the library, perform step d.

e. Install the module to module cables and terminators.
f. Tighten the rear thumb screws.
g. Tighten the thumb screw that secures the expansion module to the rear flange of each Rack Kit rail.
h. Open the I/O Station door then the Access door on the expansion module.
i. Reinstall the rack ears on the front of the expansion module to secure it to the rack (see "Replacing the Rack Ears" on page 7-20).

2. Reinstall the following expansion module components:
   a. All drive sleds (see "Replacing a Drive Sled" on page 7-43).
   b. All power supplies (see "Reinstalling/Replacing a Power Supply" on page 7-53).
3. Perform "Replacing a Control Module in a Standalone or Rack-mounted Library (14U or larger)" on page 7-11.

Installing a Replacement Expansion Module Enclosure

Important:

- Prior to removing and replacing an expansion module enclosure, visually check, and reseat if necessary, all of the internal connectors.
- On the initial power ON, you will get a T080 Service Action Ticket. Perform the suggested resolution action described in "T080: Module SN Change" on page 5-36.

Note:

1. Complete the following procedures on the old expansion module:
   - "Removing an Expansion Module from a Library" on page 7-18.

   Note: Ensure that the drive sleds and power supplies are removed from the old expansion module. They will be reinstalled into the new expansion module later in this procedure.
2. Unpack the new expansion module enclosure and place it on the work surface near the old expansion module.
3. Perform "Applying a RID Tag to a Library Module" on page 6-44.
4. Transfer the following FRUs/CRUs from the old expansion module to the new expansion module:
   a. Module communication terminator (**1** in Figure 7-49 on page 7-46).
   b. Module-to-module communication cable (4 inFigure 7-49 on page 7-46)
5. Complete "Replacing an Expansion Module in a Standalone or Rack-mounted Library (14U or larger)" on page 7-18.

   Note: Ensure drive sled and power supplies are installed in the correct locations.

Removing/Replacing Rack Ears

Rack ears are installed on each module in a rack-mounted library for weight distribution.

Removing the Rack Ears

Complete these steps to remove the rack ears on all units of the library.

1. Grasp the I/O Station handle and pull it toward you until it locks in the open position.
2. Remove the right rack ear (**1** in Figure 7-17).

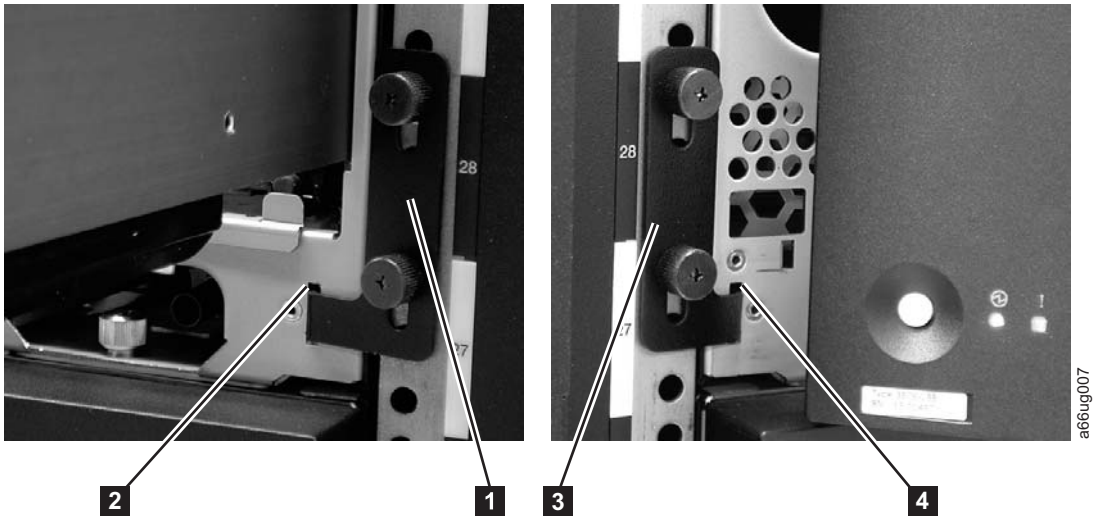

Figure 7-17. Removing the rack ears (Control Module shown)

   a. Remove the right rack ear thumb screws. If the screws are tight, use a #2 Phillips screwdriver to loosen them.
   b. Remove the right rack ear.
3. Remove the left rack ear (**3** in Figure 7-17).
   a. Open the left door of the library unit slightly.
   b. Grasp the hinged side of the door and, while pulling on the door, push right to expose the left rack ear.
   c. Remove the left rack ear thumb screws.
   d. Remove the left rack ear.
4. Repeat this process for all units in the library, if necessary.

Replacing the Rack Ears

Complete these steps to replace the rack ears on all units of the library.

1. Grasp the I/O Station handle and pull it toward you until it locks in the open position.
2. Replace the right rack ear (**1** in Figure 7-17).
   a. At the bottom right of the I/O Station position on each library unit, there is a slot (**2** in Figure 7-17). Insert the right rack ear into the slot.
   b. Position the right rack ear flush with the rack rail.
   c. Install and tighten the right rack ear thumb screws.
3. Replace the left rack ear (**3** in Figure 7-17).
   a. Open the left door of the library unit slightly.
   a. Grasp the hinged side of the door and, while pulling on the door, push right to expose the slot for the left rack ear.
   b. Insert the left rack ear into the slot (**4** in Figure 7-17).
   c. Position the left rack ear flush with the rack rail.
   d. Install and tighten the left rack ear thumb screws.

4. Repeat this process for all units in the library, if necessary.

Verifying Front and Rear Gear Racks Alignment

In order for the picker to move from one unit to the next in a multi-module library, the front (3 in Figure 7-18) and rear (1 in Figure 7-18) gear racks in the control module must be properly aligned with the gear racks in the expansion module.

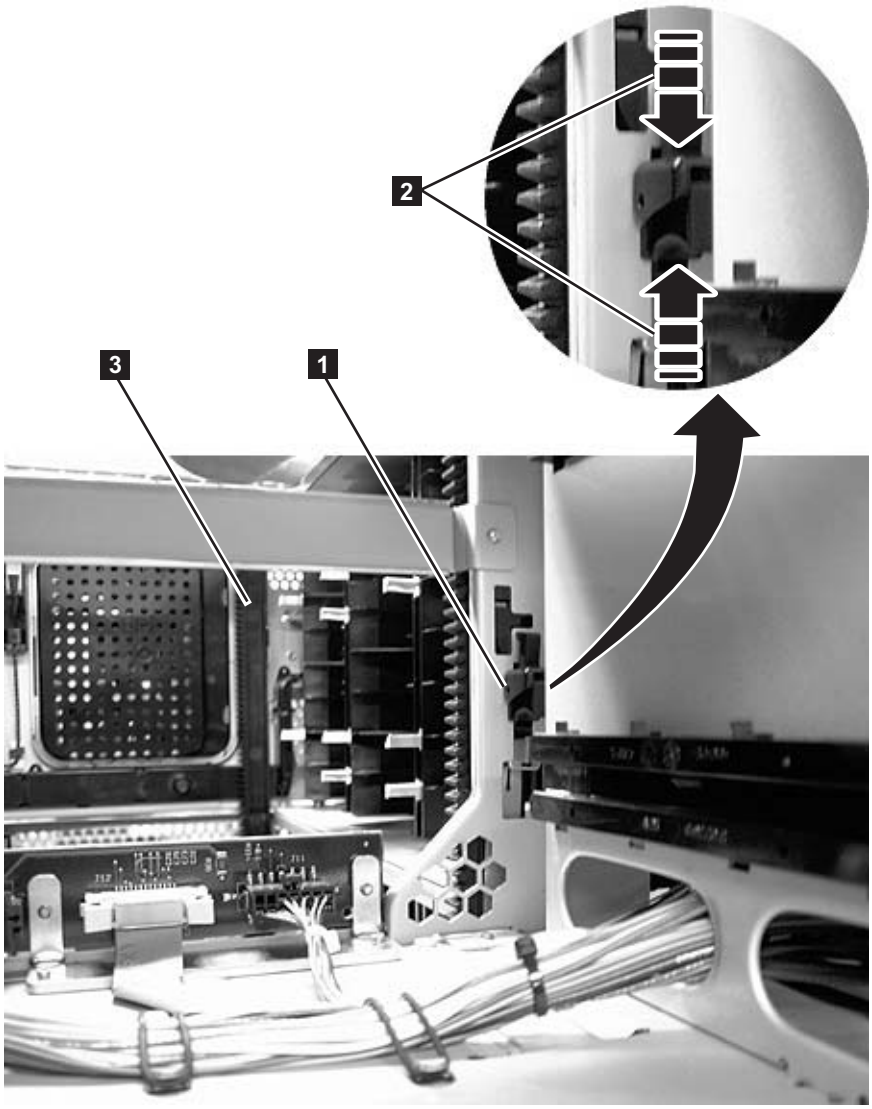

Figure 7-18. Gear rack

1	Rear gear rack locking mechanism	2	Magnification of rear gear rack locking mechanism	3	Front gear rack

Verify that the front (3 in Figure 7-18) and rear (1 in Figure 7-18) gear racks are properly aligned and positioned.

- In the bottom module of the library, verify that the gear racks are in the down position. Pinch the gear rack locking mechanism (**2** in Figure 7-18 on page 7-21) and push the gear rack down. Ensure that the lock is **not** engaged in the hole in the frame.
- In all the modules above the bottom module:
  - Verify that the gear racks are in the down position. Pinch the gear rack locking mechanism (**2** in Figure 7-18 on page 7-21) and push the gear rack down. Ensure that the lock is **not** engaged in the hole in the frame.
  - Verify that there are no gaps in the gear racks between library units.

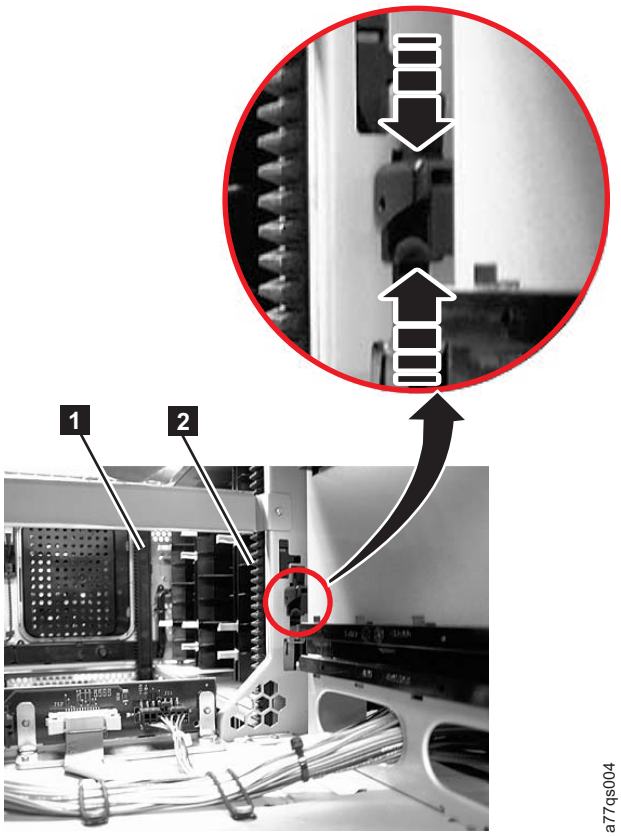

Figure 7-19. Front and back gear racks

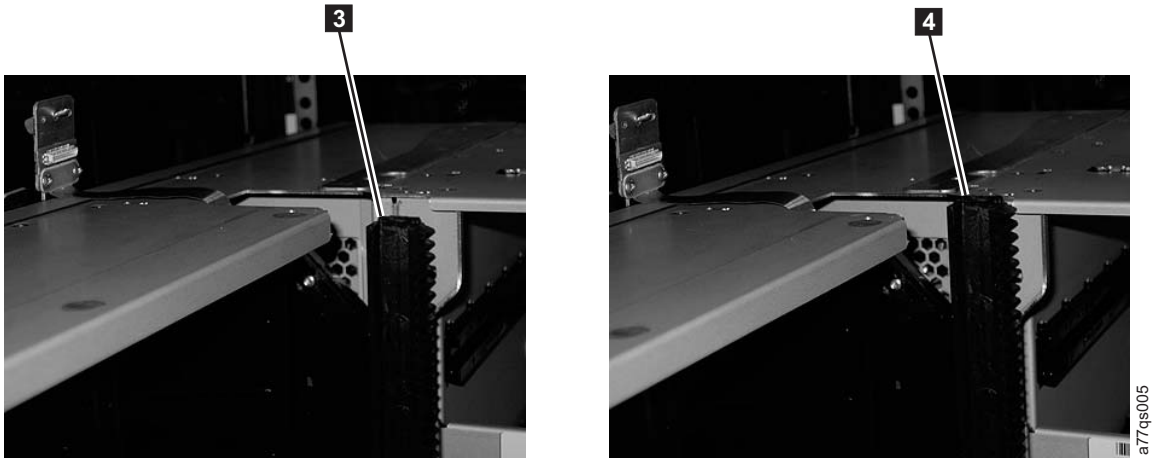

Figure 7-20. Gear racks in the up and down positions

To release the gear rack and move it down, follow these steps.

1. Engage the Y-rails of each module in your library configuration. Ensure that the Y-rails are properly aligned and the thumbscrews are tightened.

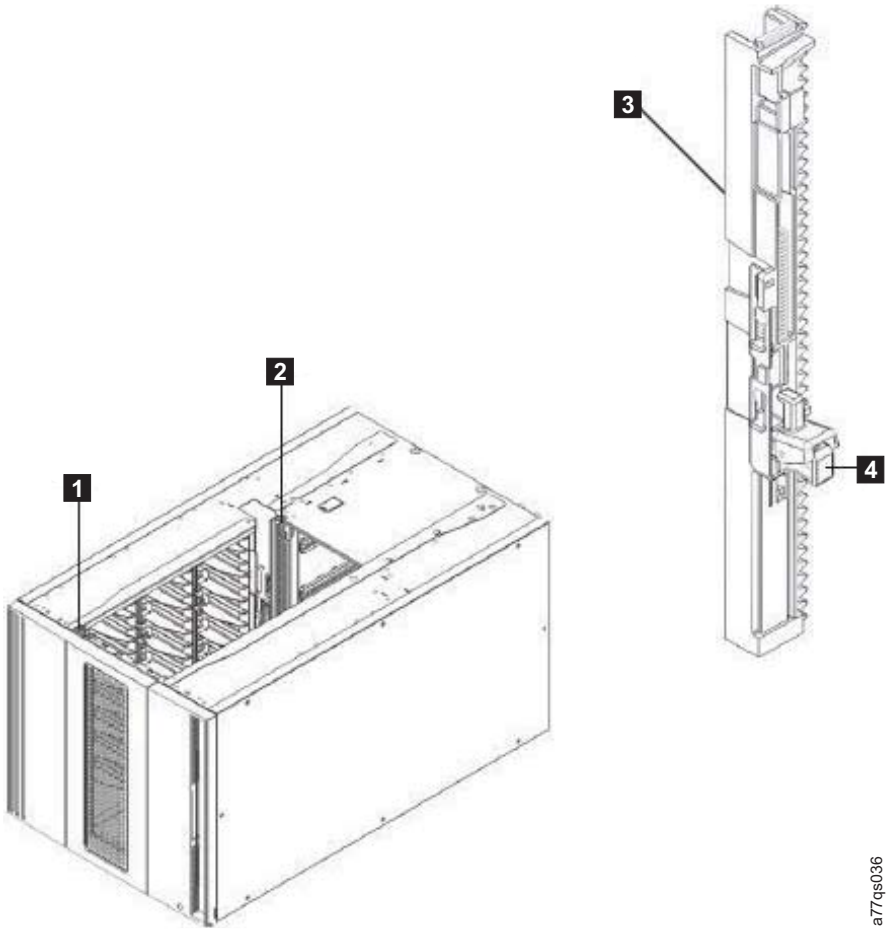

Figure 7-21. Placing gear rack in the Down position

1 The front Y-rail **3** The Y-rail (this end up)

2 The rear Y-rail 4 Squeeze here to release

2. From the front of the library, open the I/O station and access door of the 9U expansion module. Squeeze the handle of the Y-rail release mechanism, lift it out of its locked position, and slide it downward as far as it will go.

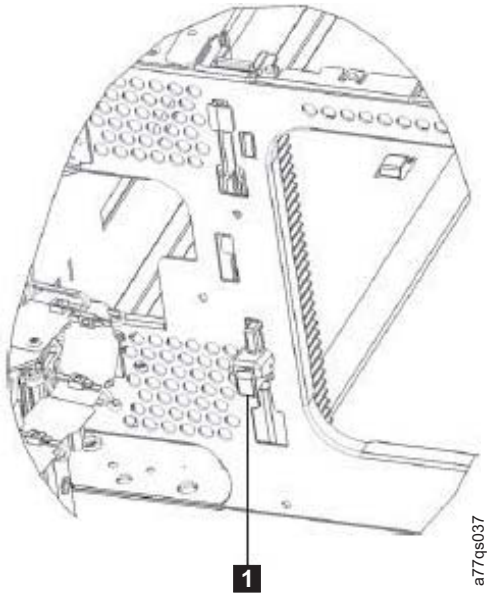

Figure 7-22. Releasing the Y-rail

1 Y-rail in unlocked, functional position

3. From the back of the library, find the rear Y-rail release mechanism, which is located in the interior of the right side of the module. Squeeze the handle of the Y-rail release mechanism, lift it out of its locked position, and slide it downward as far as it will go. Doing this aligns the Y-rails with the Y-rails of the module beneath it.

   CAUTION:
   Ensure that there is no gap between the top and bottom Y-rails on both the front and back of the library. If a gap exists, the library cannot mechanically initialize.

To align the gear racks in a multi-module library:

1. Slightly push up and pinch the gear rack locking mechanism (1 in Figure 7-18 on page 7-21) to unlock the gear rack in the control module.
2. While pinching the gear rack locking mechanism (2 in Figure 7-18 on page 7-21), push the gear rack down until it aligns with the gear rack in the expansion module, then release your hold on the locking mechanism.
3. Manually inspect the track to ensure there are no gaps.
4. Repeat Steps 1 through 3 for the other gear rack.
5. Manually raise the picker and disengage the picker locking mechanism (1 in Figure 7-23 on page 7-25) if necessary. If the gear racks are properly aligned, the picker will slowly move to the bottom of the library.

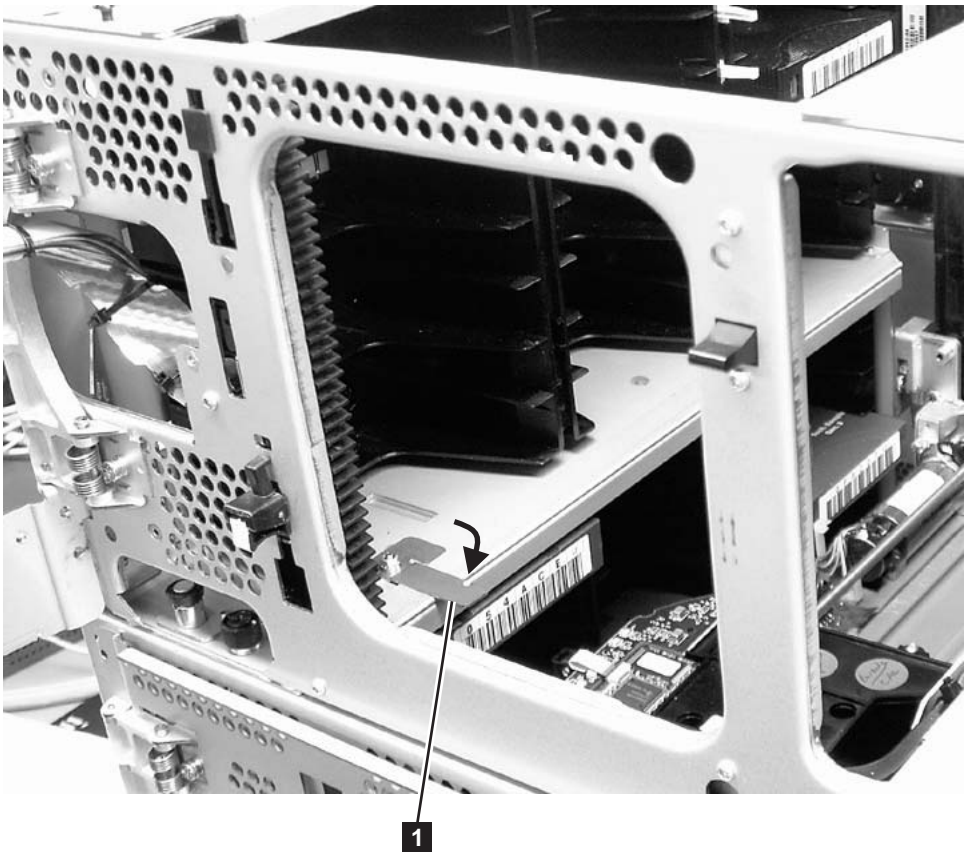

Figure 7-23. Picker assembly locking mechanism

Front Panel Components

The library has the following front panel components:

- Bezels
- Operator Panel
- I/O Station
- I/O Station Lock Assembly
- I/O Station Safety Flap
- Power Switch/LED board

Bezels

The front bezels are the design panels on the front of both the control module and the expansion module.

These instructions explain how to replace the front bezels of your library. Bezels can be replaced on both the I/O Station door and the Access Door.

Required Tool: T10 TORX screwdriver

Removing the I/O Station Bezel

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Open the I/O Station door.

3. Remove the cartridges from the I/O Station to access the screw located on the backside of the I/O Station door.
4. Remove the screw located on the backside of the I/O Station door.
5. Hold the I/O Station slide assembly in place with one hand and, using your other hand, pull the I/O Station door directly up to disengage the bolts, and then pull the door toward you.
6. Set aside the old front bezel.

Replacing the I/O Station Bezel

To replace the I/O Station bezel, perform the remove procedures in reverse order. For the last step, perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing the Access Door Bezel

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Open the module's I/O Station and Access Doors.

   Note: When you open the Access Door, the library becomes disabled (the Picker assembly does not function). When you later close the Access Door, the library will function normally.
3. Remove the screws located on the backside of the Access Door.
   - For the control module (11 screws), see **1** in Figure 7-24.

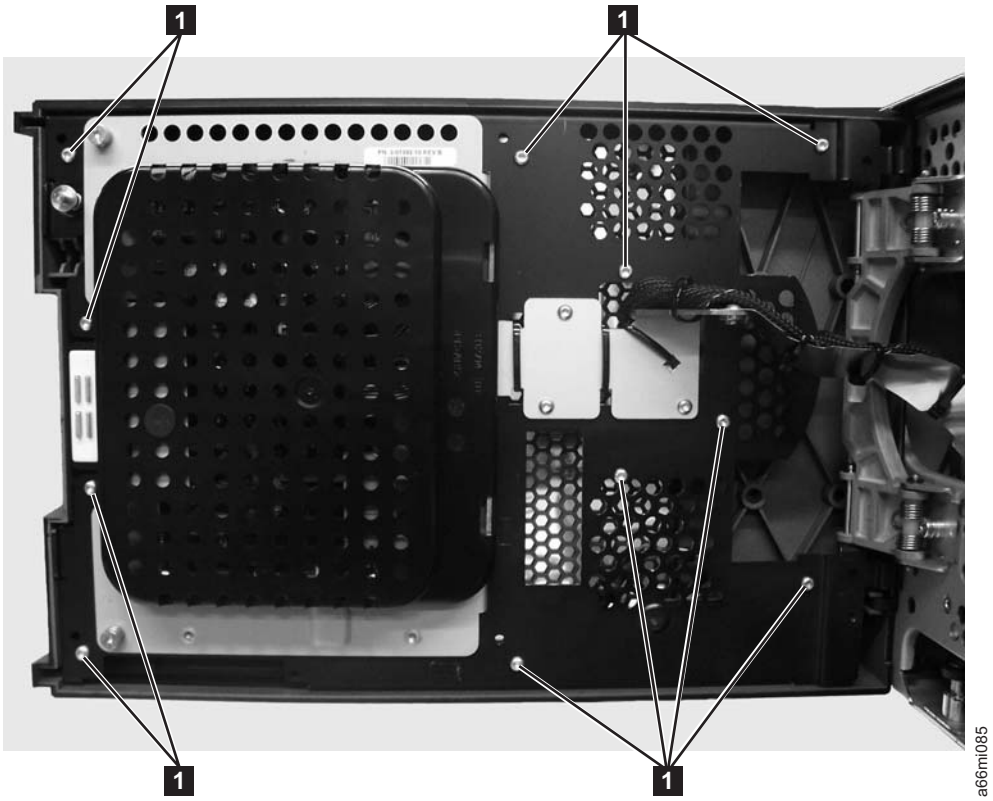

Figure 7-24. Control module Access Door screw locations

   - For an expansion module (12 screws, see **1** in Figure 7-25 on page 7-27.

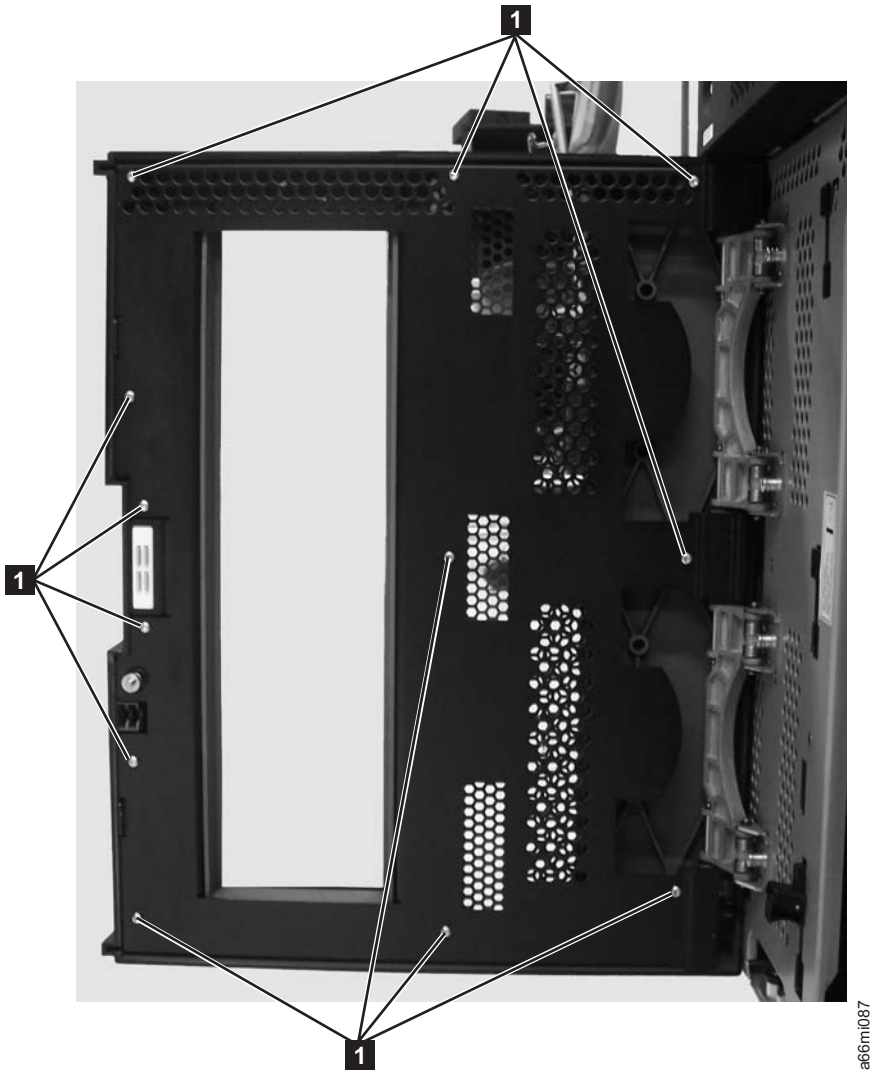

Figure 7-25. Expansion module Access Door screw locations

Replacing the Access Door Bezel

1. To install the new Access Door bezel, perform the steps in "Removing the Access Door Bezel" on page 7-26 in reverse order.
2. Copy the serial number on the label in the lower left corner of the old Access Door bezel onto the blank label supplied with the new Access Door bezel, then apply the new serial number label in the recess located in the lower left corner on the new Access Door bezel.
3. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Operator Panel

The Operator Panel enables you to control the library using the LCD screen located on the Control Module (CM) Access Door.

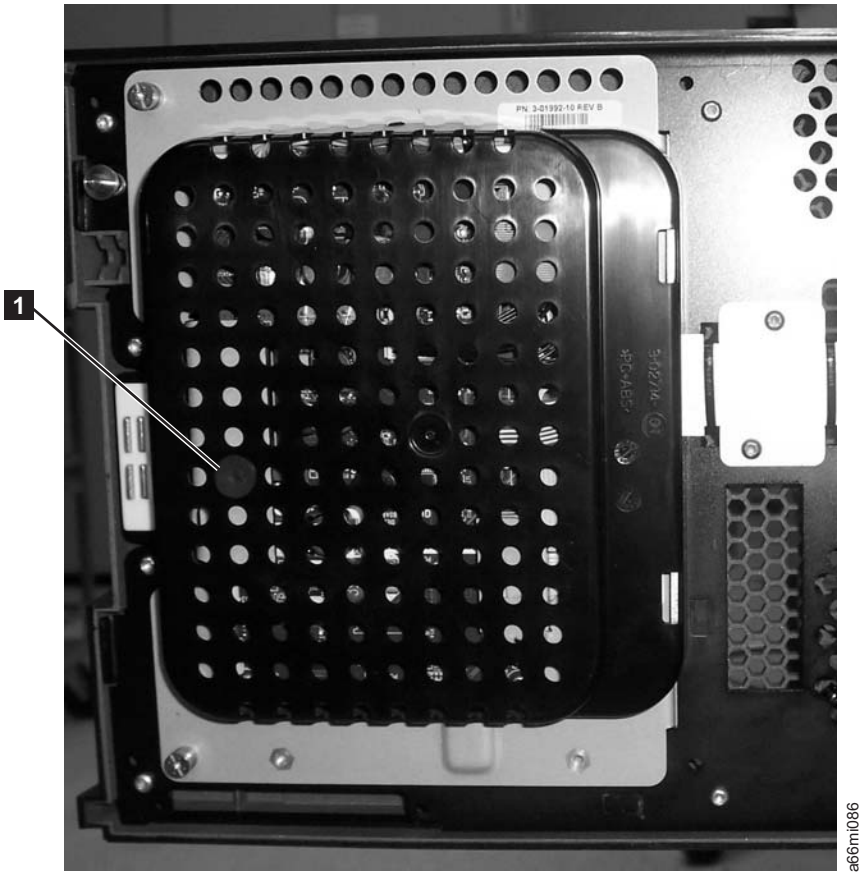

Figure 7-26. Operator Panel assembly

Before Removing / Replacing the Operator Panel

Operator panel problems may be caused by loose connectors. Visually check, and reseat if necessary, all of the connectors on the back of the operator panel (Figure 7-29 on page 7-30), the connector on the back of the I/O Station locking mechanism (**1** in Figure 7-27 on page 7-29), and the connectors that are located between the storage column 4 magazine and the back of the Library Control Blade (**2** and **3** in Figure 7-28 on page 7-29).

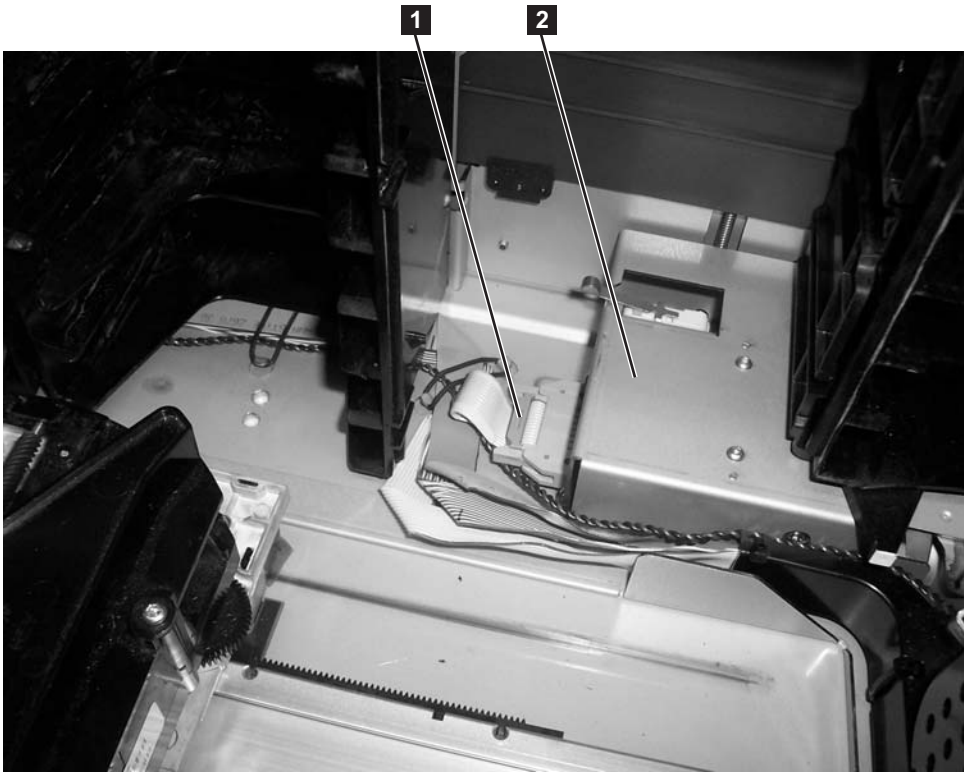

Figure 7-27. Connector on the back of the I/O Station locking mechanism

Figure 7-28. Connector between the storage column 4 magazine and Library Control Blade (top cover removed)

Removing the Operator Panel

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Open the I/O Station door.
3. Open the Access Door. The Operator Panel is located on the backside of this door.
   a. Remove the black protective cover from the back of the Operator Panel.
   b. Use a flat blade screwdriver to pry up on the plastic retaining pin (**1** in Figure 7-26 on page 7-28).
   c. Squeeze the black plastic cover on both sides to remove it from the Access Door.
4. Disconnect the four cable connectors that are attached to the Operator Panel (see **1** , **3** , **5** , and **7** in Figure 7-29).

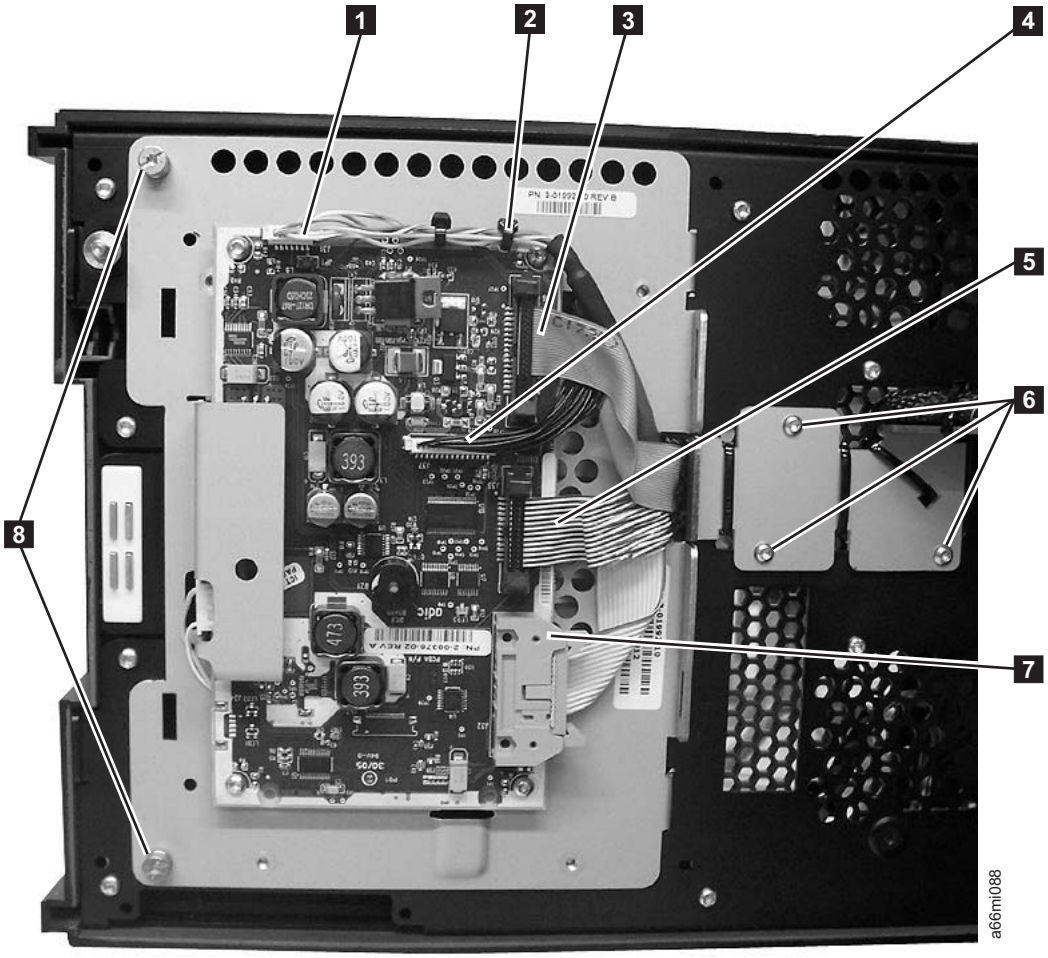

Figure 7-29. Operator Panel cabling

5. Cut the cable tie (**2** in Figure 7-29) if necessary.
6. Unscrew the two captivated screws (**8** in Figure 7-29) located on the left side of the Operator Panel.

   Important: When removing the final screw, hold the Operator panel to ensure it doesn't fall.
7. Swing the panel to the right then lift it from the Access Door.

Replacing the Operator Panel

To replace the Operator Panel, complete the removal procedure in reverse. For the last step, perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing/Replacing the Power Switch/LED Board Assembly

The Power Switch/LED Board Assembly (**1** in Figure 7-30) contains the power ON/OFF button, power ON LED, and Operator Attention LED.

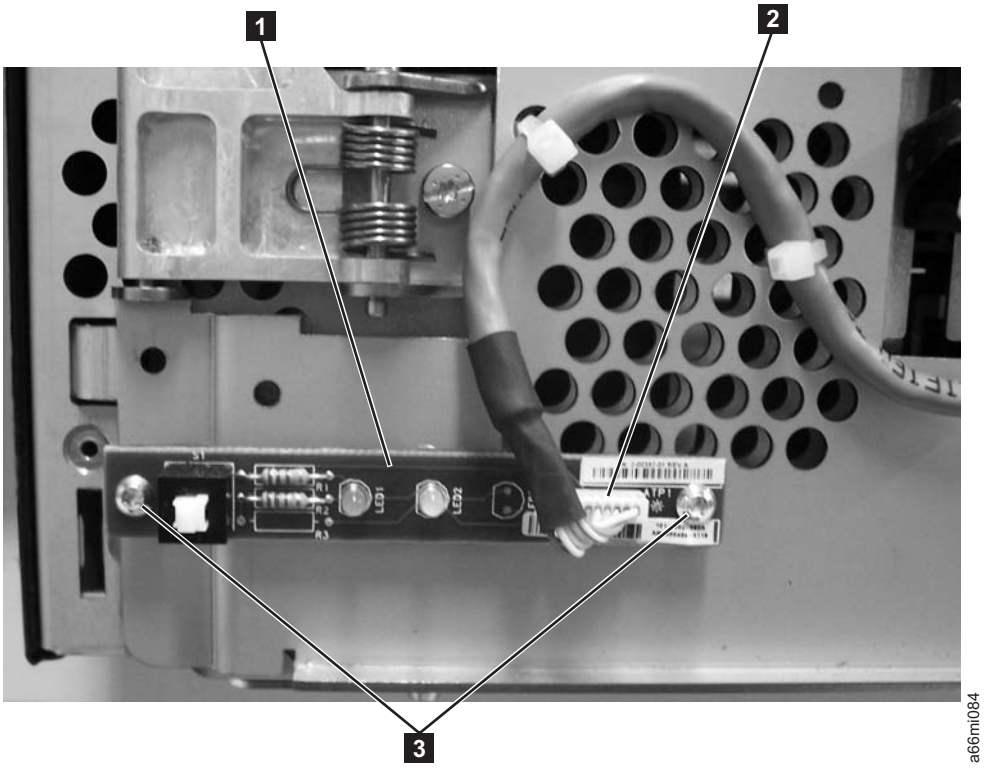

Figure 7-30. Power Switch/LED Board Assembly

Removing the Power Switch/LED Board Assembly

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Perform "Removing the Access Door Bezel" on page 7-26.
3. Disconnect the small white connector (**2** in Figure 7-30).
4. Remove the two screws (**3** in Figure 7-30).
5. Remove the Power Switch/LED Board Assembly from the Control Module. Note that the FRU kit for this assembly contains the cable and cable ties. If you suspect the cable may be failing, replace it also.

Replacing the Power Switch/LED Board Assembly

1. Perform "Removing the Power Switch/LED Board Assembly" in reverse order.
2. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

I/O Station

Each control and expansion module has an I/O Station located on the right side of the front of the unit and is used for inserting/removing data and cleaning cartridges into and out of the library.

Figure 7-31. 14U library with control module I/O Station open

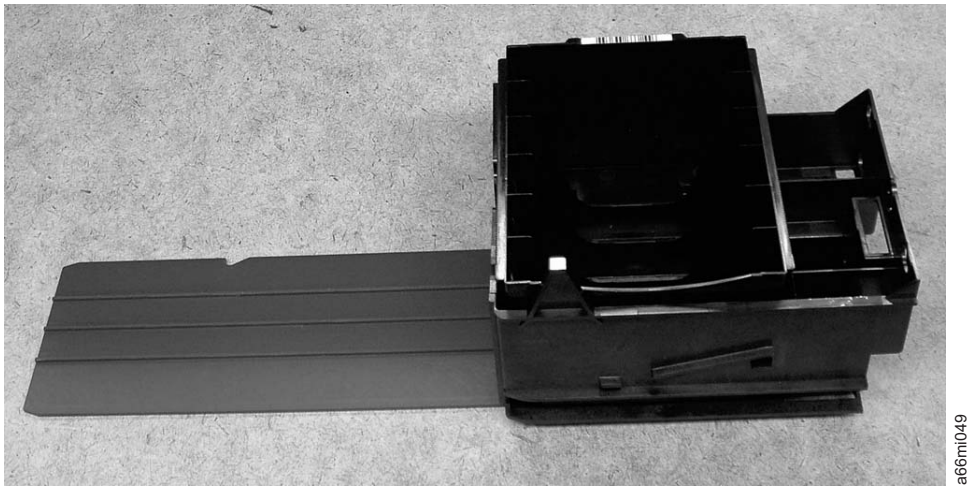

Figure 7-32. Control module I/O Station

Each module's I/O Station must be locked in order for the library to function properly. When the library is busy performing a task, such as retrieving a cartridge, the library locks all I/O Station doors. The doors cannot be opened until the library is no longer busy. If the library detects that an I/O Station door is either open or unlocked, the library cannot operate normally.

Manually Unlocking the I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

There are 2 styles of I/O Station Lock mechanisms. The early style uses a T10 Torx wrench to rotate the lock mechanism. The new style has a large push-button type mechanism behind the hole (1 in Figure 7-33) in the I/O station door.

Manually Unlocking the Early Style I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

To manually unlock the early style I/O Station lock, follow these steps:

1. Insert a T10 Torx wrench in the hole (1 in Figure 7-33) located on the front of the I/O Station door of the library module you wish to open.
2. Turn the wrench one-quarter turn counterclockwise to unlock the door.

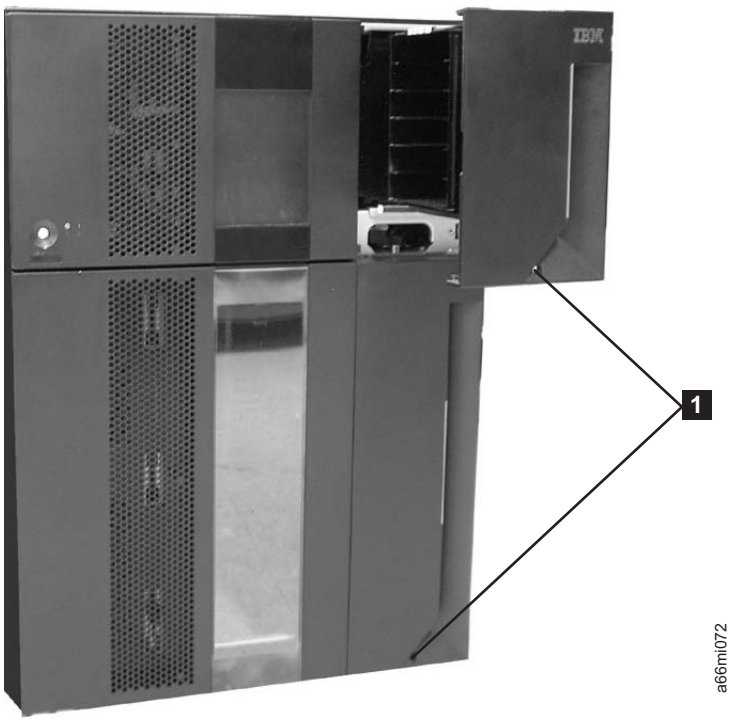

Figure 7-33. Access holes for manually unlocking I/O Station doors

3. To manually relock the I/O Station door:
   - From the Operator Panel, select **Operations** > **Lock I/O Station**
   - From the Web User Interface, select **Manage Cartridges** > **Lock/Unlock I/O Station Doors**

Manually Unlocking the New Style I/O Station Door

If the I/O Station door fails to unlock, you can unlock it manually.

To manually unlock the new style I/O Station lock, follow these steps:

1. Insert any straight tool (screwdriver, Torx wrench, etc.) into the hole (1 in Figure 7-33) in the front cover of the I/O station.

2. Push the tool in to unlock the I/O station door. There is a large, flat pushbutton type mechanism behind the hole in the cover that, when pushed toward the rear of the library, will release the I/O station lock mechanism.
3. To manually relock the I/O Station door:
   - From the Operator Panel, select **Operations** > **Lock I/O Station**
   - From the Web User Interface, select **Manage Cartridges** > **Lock/Unlock I/O Station Doors**

Removing an I/O Station

1. Open the I/O Station door, then the Access Door.
2. Reaching through the Access Door opening, push up on the roller (**1** in Figure 7-34) located above the I/O Station slide and pull the I/O Station towards you until the slide is in front of the roller.

   Note: The I/O Station in an expansion module has two slides and two silver rollers. Push up on one of the rollers while you pull out on that part of the I/O Station, then push up on the other roller to release the I/O Station. If necessary, the silver rollers may be pushed up far enough to latch in the cutout hole in the side frame. Ensure that they are unlatched when the I/O station is reinstalled.

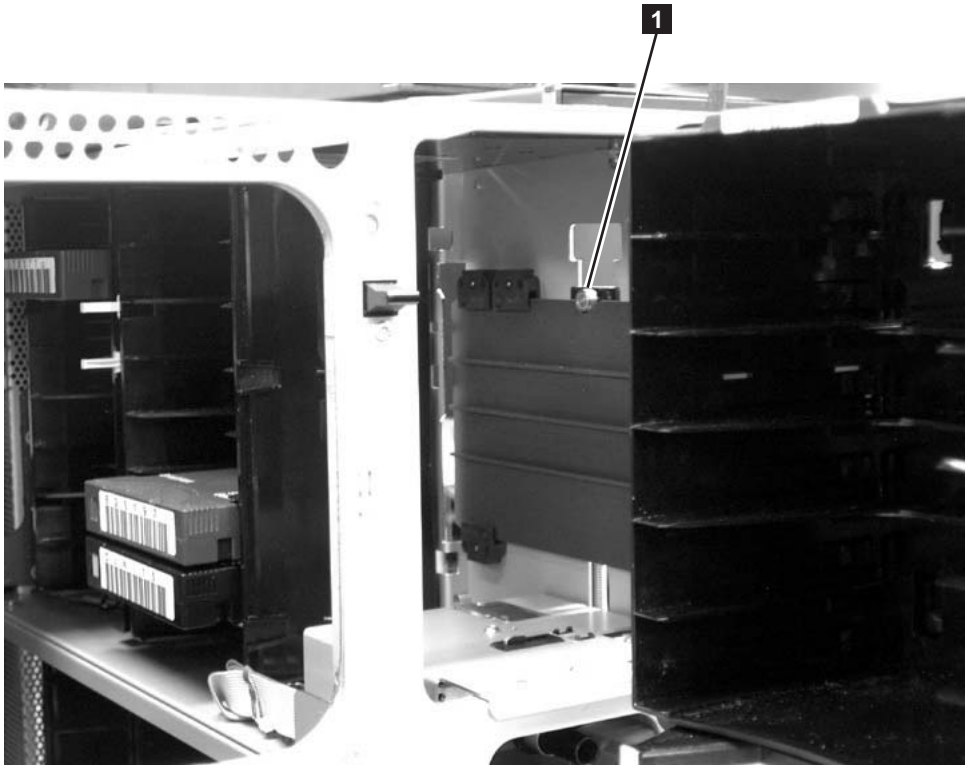

Figure 7-34. Silver roller locking the I/O Station slide in place

3. Supporting the I/O Station from underneath with your other hand, pull it out of the library module.
4. Place the I/O Station in a safe location.

Reinstalling an I/O Station

1. Supporting the I/O Station from underneath with your other hand, slide the I/O Station into the glide slots in the library unit.
2. Reaching through the Access Door, push up on the silver roller (**1** in Figure 7-34 on page 7-34) while continuing to push the I/O Station into the library module.

   Note: If you tilt the I/O station slide(s) down as they contact the roller(s), they will go under the rollers without the rollers being pushed up.
3. Release your hold on the silver roller to lock the I/O Station slide in place.
4. Close the Access Door, then close the I/O Station door.

Removing the I/O Station Lock Assembly

The I/O Station lock assembly (**1** in Figure 7-35) contains the lock sensor and lock solenoid.

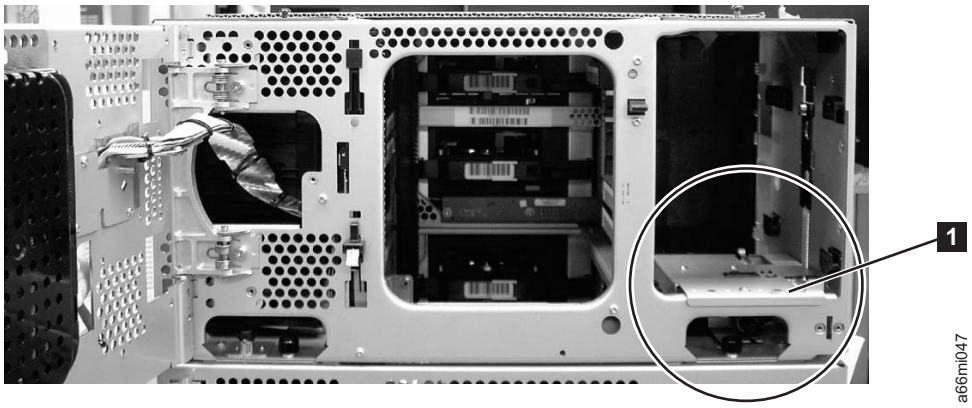

Figure 7-35. I/O Station Lock Assembly installed in library

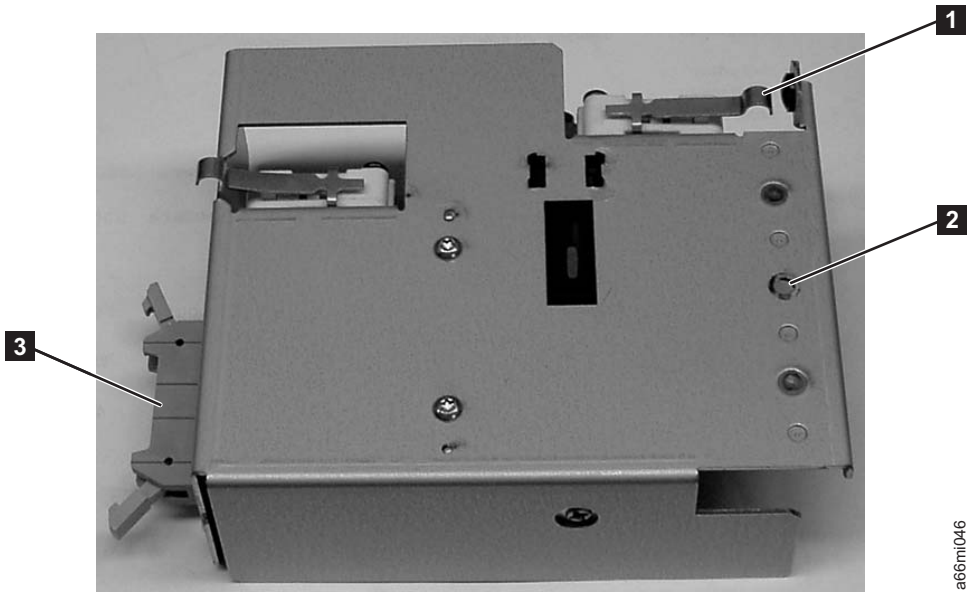

Figure 7-36. I/O Station Lock Assembly (top view)

1. Perform “Preparing a Library or Library Module for Repairs” on page 7-3.
2. Open the I/O Station and Access doors of the control module.

   Note: If the I/O Station door is locked, see “Manually Unlocking the I/O Station Door” on page 6-43
3. Perform “Removing an I/O Station” on page 7-34.
4. Remove the mounting screw (**2** in Figure 7-36 on page 7-35), and set it aside.
5. Disconnect the I/O Station cable (**3** in Figure 7-36 on page 7-35) from the lock assembly.
6. Remove the lock assembly from the module enclosure.

Replacing the I/O Station Lock Assembly

1. Perform “Removing the I/O Station Lock Assembly” on page 7-35 in the reverse order.

   Important:

   a. When installing the lock assembly, be careful not to damage any of the cables or connector pins.
   b. Ensure that the back end of the lock assembly fits into the appropriate slot at the bottom of the enclosure.
   c. Ensure the I/O Station switch actuator lever (**1** in Figure 7-36 on page 7-35) is not stuck under the enclosure sheet metal and operates without binding on the enclosure.
2. Perform “Returning a Library or Library Module to Normal Operations after Repairs” on page 7-3.

Removing the I/O Station Safety Flap from a Control Module (5U)

1. Perform “Removing an I/O Station” on page 7-34.
2. Unhook the front spring wire (**1** in Figure 7-37 on page 7-37) from the tab on the I/O flap.

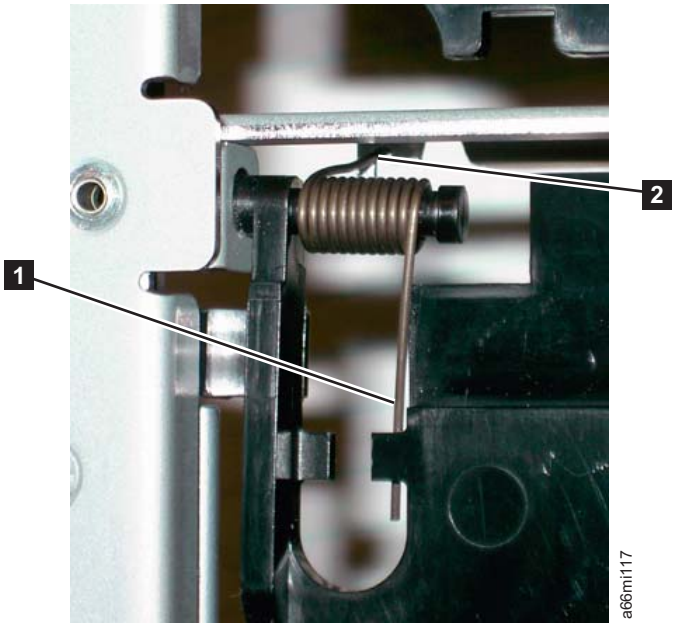

Figure 7-37. I/O Safety Flap Front Spring Wire

3. Push the upper right hand corner of the flap to the left to remove the pivot pin (**1** in Figure 7-38) from the pivot hole (**2** in Figure 7-38).

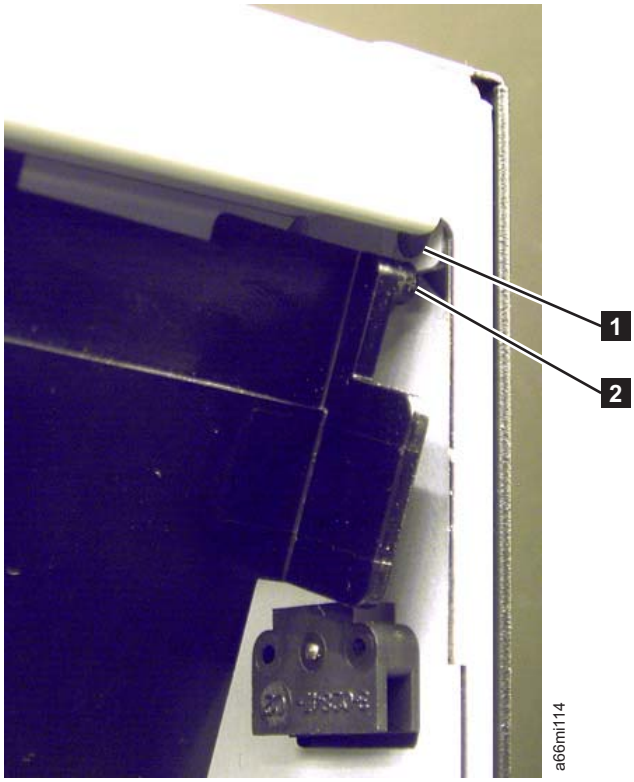

Figure 7-38. I/O Safety Flap Pivot Pin

4. Move the flap to the right to remove the pivot pin (**1** in Figure 7-39 on page 7-38) from the pivot hole (**1** in Figure 7-39 on page 7-38). The flap can now be

removed from the library.

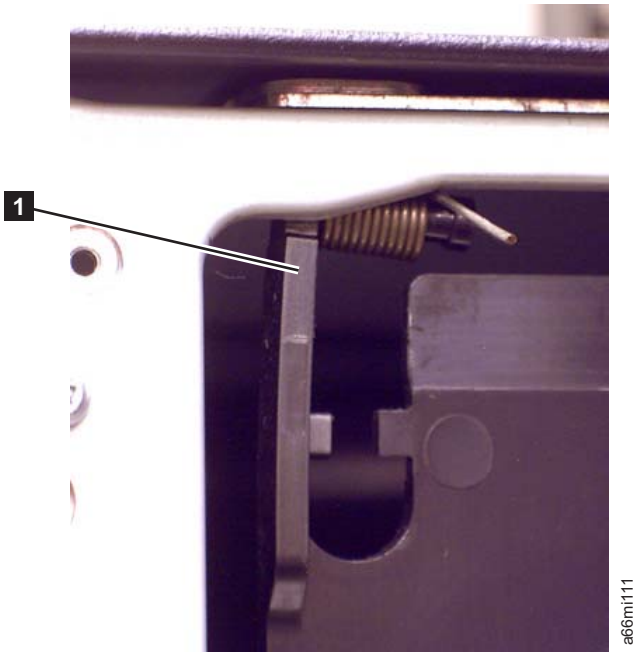

Figure 7-39. I/O Safety Flap Pivot Pin, Removed

Replacing the I/O Station Safety Flap in a Control Module (5U)

Perform "Removing the I/O Station Safety Flap from a Control Module (5U)" on page 7-36 in the reverse order. When installing the bottom flap, position the spring (**1** in Figure 7-40) as shown.

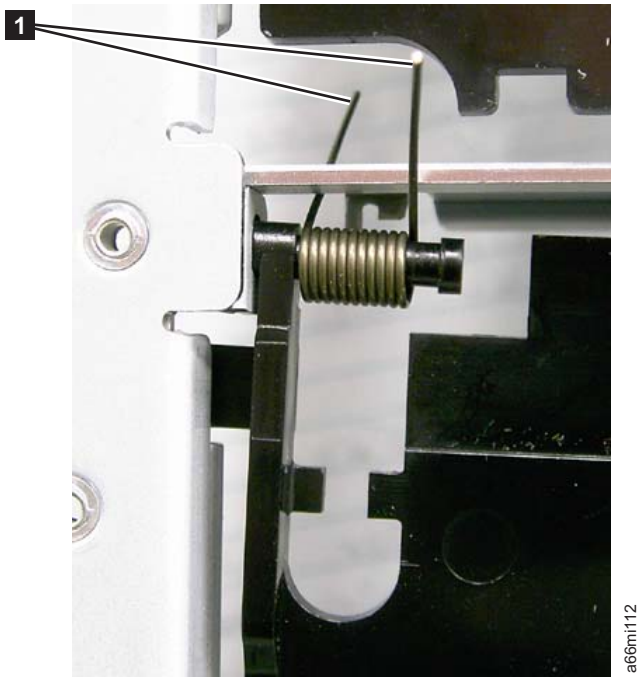

Figure 7-40. I/O Station Safety Flap Bottom Spring position

Removing the I/O Station Safety Flap from an Expansion Module (9U)

1. Perform "Removing an I/O Station" on page 7-34.
2. Unhook the front spring wire (1 in Figure 7-41) from the tab on the I/O flap.

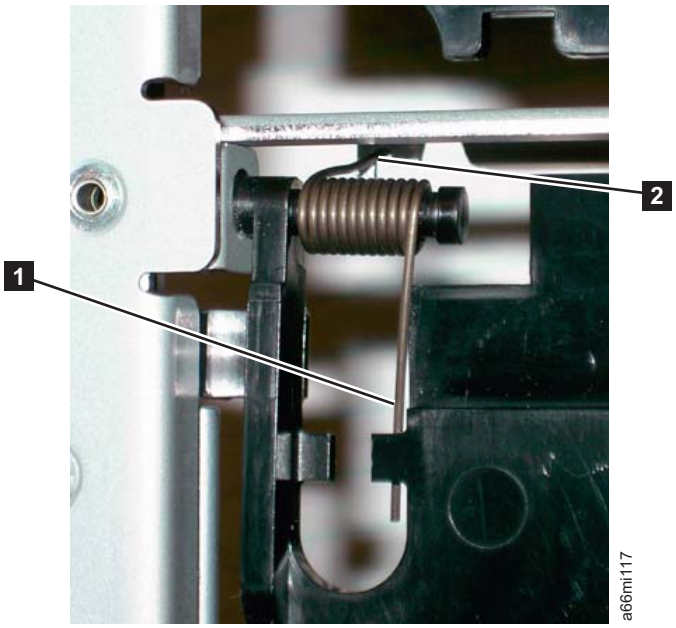

Figure 7-41. I/O Safety Flap Front Spring Wire

3. Unhook the rear spring wire (2 in Figure 7-41) from the notch in the frame.
4. Disconnect the plastic link (1 in Figure 7-42 on page 7-40) from the bottom flap (3 in Figure 7-42 on page 7-40). Use a small screwdriver (2 in Figure 7-42 on page 7-40) to pry the link out of the hole in the bottom flap.

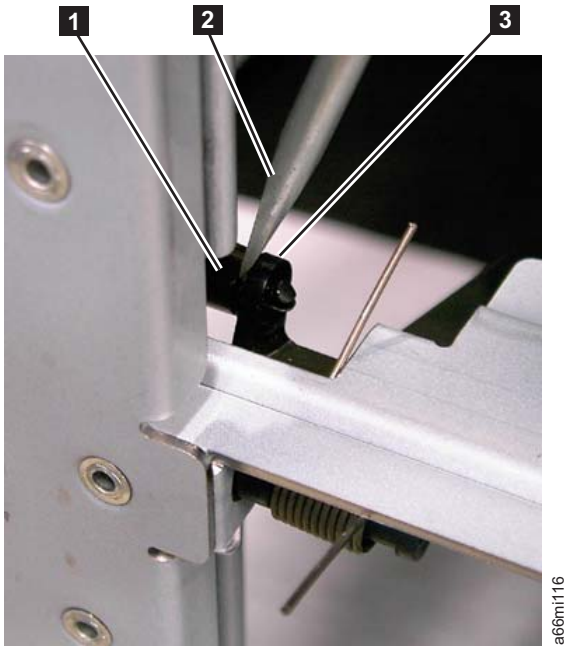

Figure 7-42. I/O Safety Flap Link

5. Push the upper right hand corner of the bottom flap to the left to remove the pivot pin (**1** in Figure 7-43) from the pivot hole (**2** in Figure 7-43).

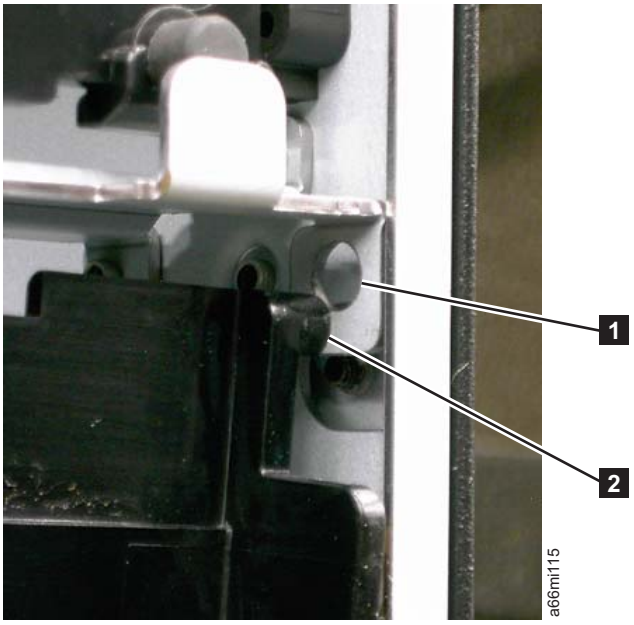

Figure 7-43. I/O Safety Flap Pivot Pin

6. Move the bottom flap to the right to remove the pivot pin (**1** in Figure 7-44 on page 7-41) from the pivot hole (**1** in Figure 7-44 on page 7-41). The bottom flap can now be removed from the library.

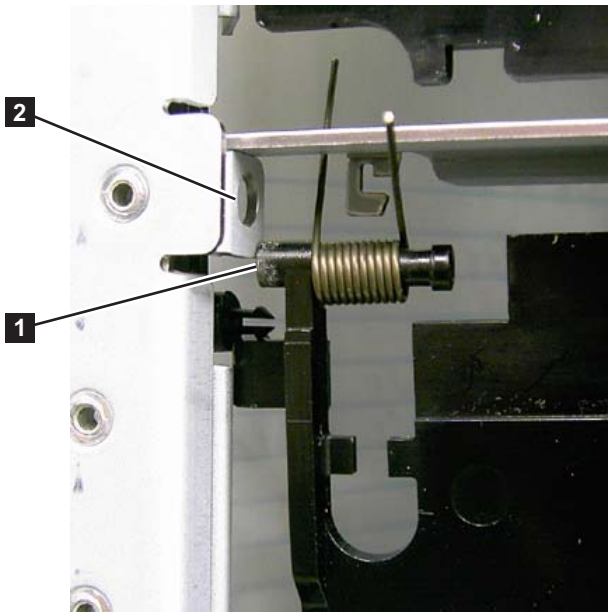

Figure 7-44. I/O Safety Flap Pivot Pin, Removed

7. Repeat steps 5 and 6 above to remove the top flap from the library.

Replacing the I/O Station Safety Flap in an Expansion Module (9U)

Perform "Removing the I/O Station Safety Flap from an Expansion Module (9U)" on page 7-39 in the reverse order. When installing the bottom flap, position the spring (**1** in Figure 7-45) as shown.

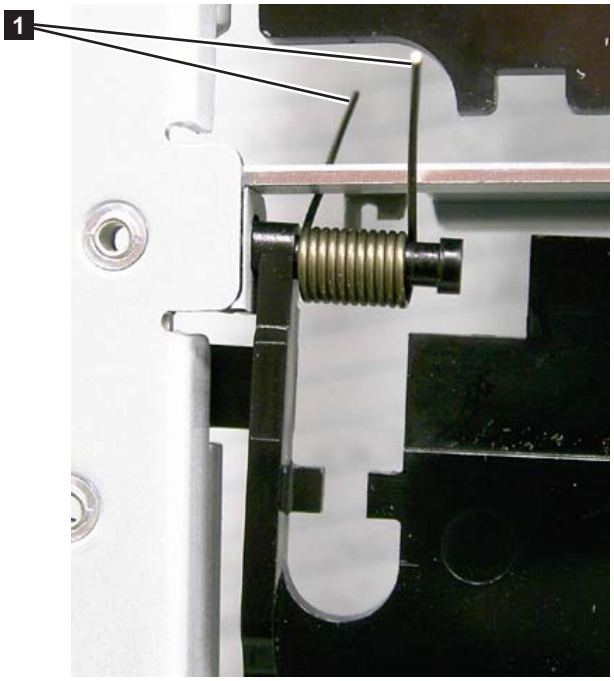

Figure 7-45. I/O Station Safety Flap Bottom Spring position

Rear Panel Components

The library has the following rear panel customer replaceable units (CRUs):

- Drive Sled
- Library Control Blade (LCB)
- Library Power Supply

Drive Sled

Tape drives mounted in sleds are installed into tape drive slots in the rear of the library.

Removing a Drive Sled

Important: If removing more than one drive sled at a time, record the locations of each drive before they are removed. Ensure that the drives are reinstalled in the correct location.

1. Vary all drives offline from the host.
   - From the Operator Panel, select **Operations** > **Change Drive Mode**.
   - From the Web User Interface, select **Manage Drives** > **State (Online/Offline)** .

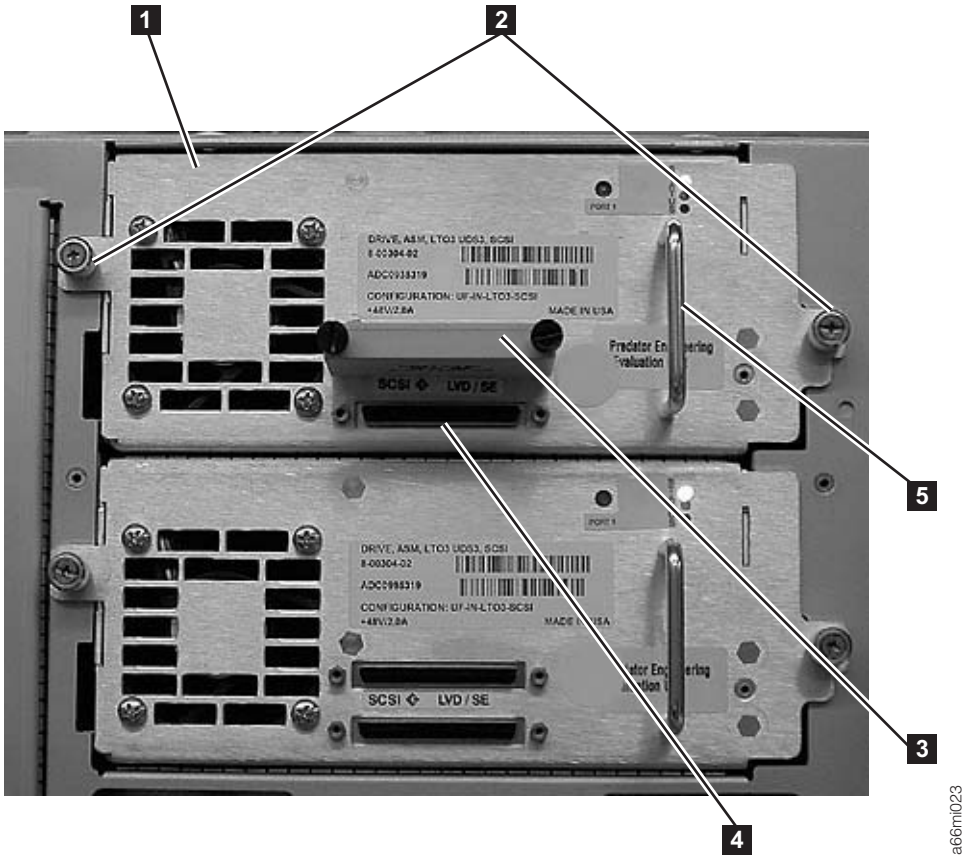

Figure 7-46. Drive sled (detail)

2. Disconnect the drive cable and place it on a flat surface in a secure location to avoid damaging the cable.

a. For a SCSI drive, loosen the two thumb screws that hold the SCSI cable and terminator in place by turning them counterclockwise. Disconnect the cable and terminator from the drive being removed.

b. For a Fibre Channel or SAS drive, unplug the host interface cable.

3. Loosen the two thumb screws (2 in Figure 7-46 on page 7-42) that hold the drive in place by turning them counterclockwise.
4. Slide the drive out of the library module. Grasp the handle (5 in Figure 7-46 on page 7-42) and slowly pull the drive toward you, while supporting the drive sled from underneath.

   Note: Removing a drive sled with power ON will generate a Service Action Ticket T012.

Replacing a Drive Sled

Attention: NEVER install a drive sled when a cartridge is in the drive in the eject position. Remove the cartridge first.

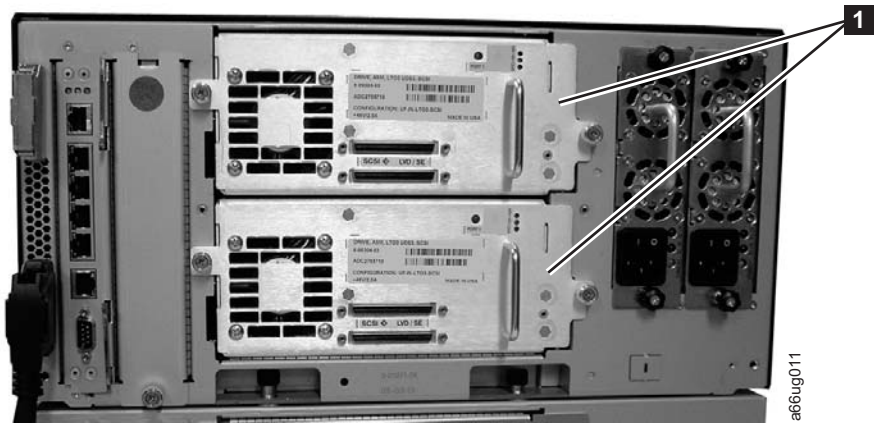

Figure 7-47. Control Module Drive Sled

1. Align the drive sled with the guide rails and guide slots along the tracks (3 in Figure 7-48 on page 7-44) in the open drive sled slot (2 in Figure 7-48 on page 7-44). Grasp the handle (5 in Figure 7-46 on page 7-42) and slowly slide the drive sled into the library, while supporting the drive sled from underneath.

   Note: The thumb screws must be aligned with the screw holes in the module. If they are not aligned, the drive sled was not inserted correctly.

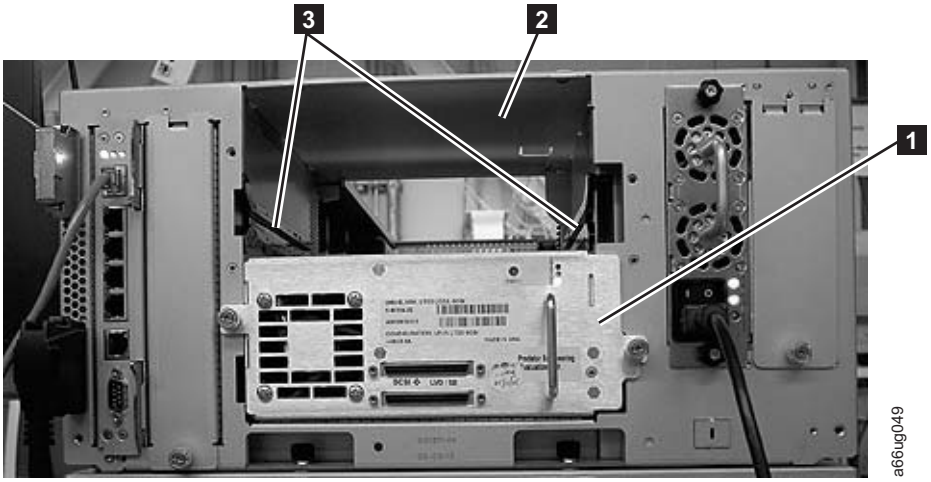

Figure 7-48. Drive sled slot

2. Tighten the two thumb screws (**2** in Figure 7-46 on page 7-42) that hold the drive sled in place by turning them clockwise.
3. Reconnect the drive sled cable.
   a. For a SCSI drive sled, plug the cable and terminator into the drive sled. Tighten the thumb screws that hold the SCSI cable (**4** in Figure 7-46 on page 7-42 shows the SCSI receptacle) and terminator (**3** in Figure 7-46 on page 7-42) in place by turning them clockwise.
   b. For a Fibre Channel or SAS drive sled, connect the host interface cable.
4. Repeat this procedure for all drives to be reinstalled in the library.
5. Ensure that all new drives being installed have the correct firmware level. New drive CRUs from stock may have downlevel firmware. All drives of a given interface and drive type should have the same firmware level.
   a. From the operator panel: **Tools** > **Drive Info**.
   b. From the Web user interface: **Service Library** > **View/Update Drive Firmware Levels** .
6. Update the drive firmware, if necessary.
7. Vary all drives online from the host.
8. If a new drive is installed in place of the drive that was removed, it will be necessary that the host application be reconfigured to recognize the Vital Product Data (VPD) of the new drive. This will prevent possible communication and backup application disruptions.

   Note: This does not need to be performed if Logical serial number addressing had been implemented at a prior date.

Library Control Blade or Compact Flash Card

The Library Control Blade (LCB) manages the entire library, including the Operator Panel and picker assembly. It also runs system tests to ensure that the library is functioning properly.

The Compact Flash (CF) Card is housed on the LCB and contains the library firmware and vital product data (VPD) such as configuration settings.

Replacement of either the LCB or the CF requires the removal of the LCB/CF Assembly from the library.

Important: Before removing the LCB/CF Assembly from the library, ensure that you have performed "Saving/Restoring System Configuration" on page 6-13 and that the saved file is available. If the CF card is replaced, you will need this file to reconfigure the library.

Following is a partial list of the configuration items that are saved:

- Current library firmware
- Network settings:
  - IP Address
  - Subnet Mask & Gateway addresses
- Feature Code licenses keys
- Logical library configuration
- Cartridge slot assignments
- Cleaning slot configuration
- I/O Station configuration
- Drive IDs:
  - SCSI ID
  - Fibre Loop ID
  - SAS ID
- Encryption method selections
- Administrator and user account information

Removing the Library Control Blade/ Compact Flash Assembly

Important: Before removing the LCB/CF Assembly from the library, ensure that you have the current library configuration data available. If the CF card is replaced, you will need the following information to reconfigure the libary:

- IP address
- Subnet mask address
- Gateway address
- Library firmware level
- License keys, if applicable

See "Saving/Restoring System Configuration" on page 6-13. Also, see Appendix E: "Library Configuration Form" in the *TS3310 Setup and Operator Guide*.

Important: When handling the LCB, you must wear an ESD anti-static wrist strap, or touch the library frame to discharge any static electricity in your body. Do not handle the LCB without taking appropriate ESD precautions.

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. On the LCB (Figure 7-49 on page 7-46), disconnect the Ethernet cable (**2** in Figure 7-49 on page 7-46) by pinching the tab to disengage the cable, and then pull the connector out of the LCB.

   Note: Six slots reside below the Ethernet cable. The four topmost slots are reserved for future use. The two bottommost slots are designated as Ethernet (**5** in Figure 7-49 on page 7-46) and serial (**6** in Figure 7-49 on page 7-46

on page 7-46) ports, and are reserved for use by IBM Service Personnel.

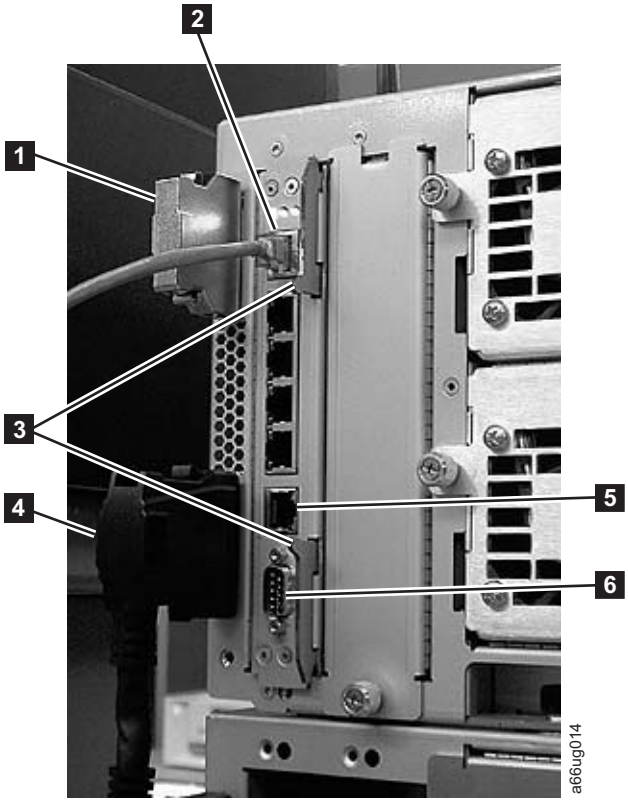

Figure 7-49. Library Control Blade (LCB)

1	Module communication terminator	4	Module-to-module communication cable
2	Ethernet cable (customer supplied)	5	Ethernet port (for IBM service personnel use)
3	Latches	6	Serial port (for IBM service personnel use)

3. Grasp the pair of latches (3 in Figure 7-49) near the top and bottom of the LCB. Simultaneously push the latches to the left, and then pull them out and away from the LCB.
4. Simultaneously grasp the same pair of latches again, and slowly pull them toward you. As the LCB begins to slide out of the control module, be sure to support the LCB from underneath, being careful to touch only the metal cover and the ground plane.

   Important: DO NOT touch any components on the LCB firmware board. Hold it by the metal cover and support it by the metal ground plane along the bottom edge.
5. Once the LCB has been removed from the control module, carefully lay it (Figure 7-50 on page 7-47) on a clean, flat surface.

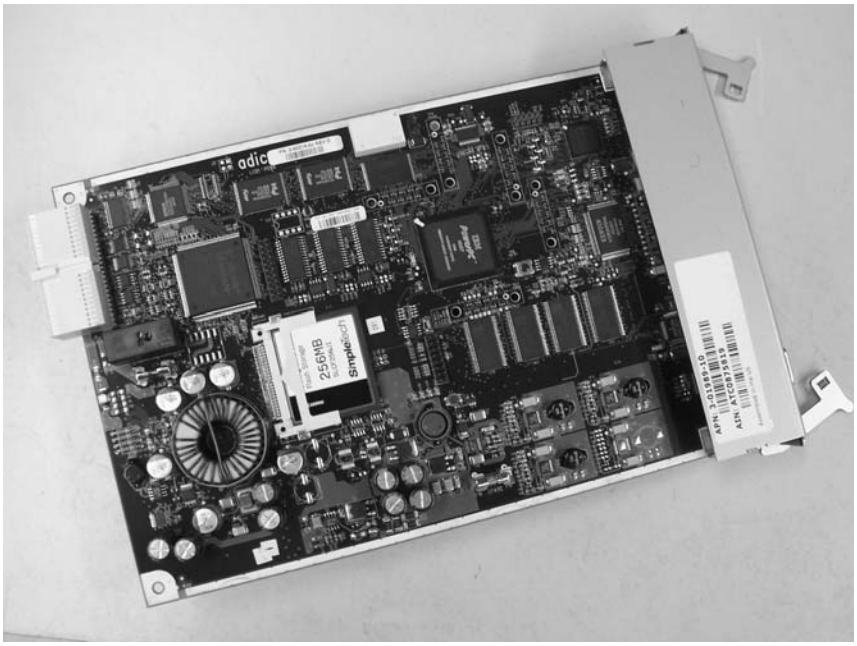

Figure 7-50. Library Control Blade (LCB)

6. Use one of the following procedures to complete the repair:
   - If you are replacing the LCB only, it will be necessary to transfer the CF card from the old LCB to the new LCB. Continue with "Removing/Replacing the Compact Flash Card."
   - If you are replacing the CF card only, it will be necessary to remove the failing CF card from the LCB, replace it with the new CF card, and upgrade the CF card firmware. Continue with Step 3 of "Removing/Replacing the Compact Flash Card".

Removing/Replacing the Compact Flash Card

Important: When handling the Compact Flash Card, you must wear an ESD anti-static wrist strap, or touch the library frame to discharge any static electricity in your body. Do not handle the Compact Flash Card without taking appropriate ESD precautions.

Selections made during library configuration reside on the Compact Flash Card.

Important: Before removing the LCB/CF Assembly from the library, ensure that you have performed "Saving/Restoring System Configuration" on page 6-13 and that the saved file is available. If the CF card is replaced, you will need this file to reconfigure the library.

Following is a partial list of the configuration items that are saved:

- Current library firmware
- Network settings:
  - IP Address
  - Subnet Mask & Gateway addresses
- Feature Code licenses keys
- Logical library configuration

- Cartridge slot assignments
- Cleaning slot configuration
- I/O Station configuration
- Drive IDs:
  - SCSI ID
  - Fibre Loop ID
  - SAS ID
- Encryption method selections
- Administrator and user account information

See Appendix E of the TS3310 Setup and Operator Guide.

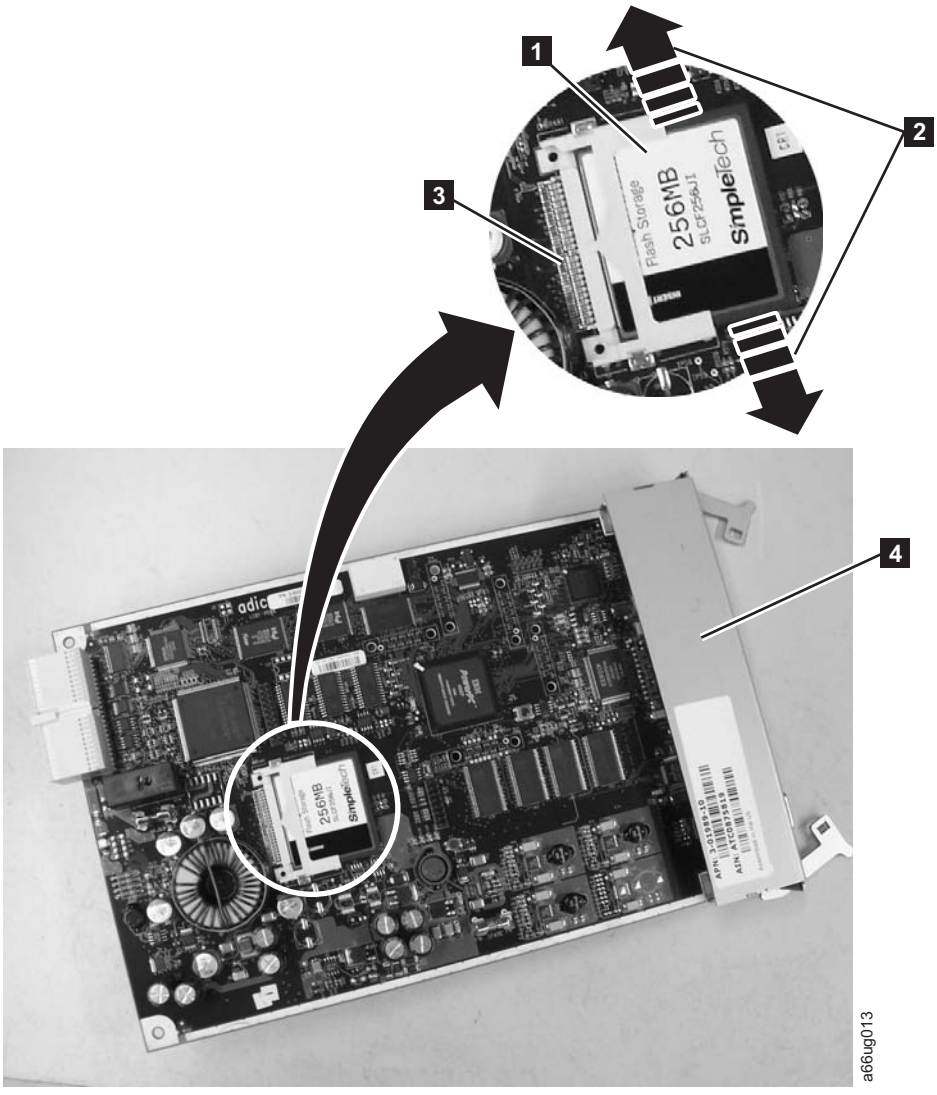

Figure 7-51. Removing the Compact Flash Card from the Library Control Blade

1. Locate the compact flash card component on the LCB board (**1** in Figure 7-51).
2. Without touching any other components on the LCB firmware board, carefully grasp the compact flash card and wiggle it using a gentle, side-to-side motion (**2** in Figure 7-51) until the pins on the compact flash card become

disconnected from the pins on the LCB board (3 in Figure 7-51 on page 7-48). Then, slowly slide the compact flash card out of the guide slots.

3. Carefully lift the compact flash card out of the LCB board.
4. If you are installing a new LCB, continue by transferring the old CF to the new LCB. If you are installing a new CF card, continue by installing the new CF card in the old LCB. In either case, install the appropriate compact flash card to the LCB board you are installing with the label up, and pins aligned. Without touching any other components on the LCB board, carefully grasp the compact flash card, and slowly slide it into the guide slots. Continue to push the compact flash card into the guide slots until the pins start to connect. Then hold the LCB board metal connector shield (4 in Figure 7-51 on page 7-48) with one hand and push the compact flash card into the connector with your other hand. The compact flash card should be firmly seated against the connector (3 in Figure 7-51 on page 7-48).

   Note: The card is properly connected when no gold pins are visible.

Replacing the Library Control Blade (LCB)

Important: When handling the LCB, you must wear an ESD anti-static wrist strap, or touch the library frame to discharge any static electricity in your body. Do not handle the LCB without taking appropriate ESD precautions. DO NOT touch any components on the LCB firmware board (see Figure 7-50 on page 7-47). Hold it by the metal cover and support it by the metal ground plane only.

1. Locate the empty LCB slot on the rear panel of the control module (CM). Then, carefully line up the new LCB board along the guide slots, and gently slide it into the control module until the connector seats.

   Important: As the LCB begins to slide into the control module, be sure to support the circuit board from underneath, being careful to touch only the metal cover and the ground plane along the bottom edge.

2. Grasp the pair of latches near the top and bottom of the LCB (3 in Figure 7-52 on page 7-50) by pushing them in until they click into place.

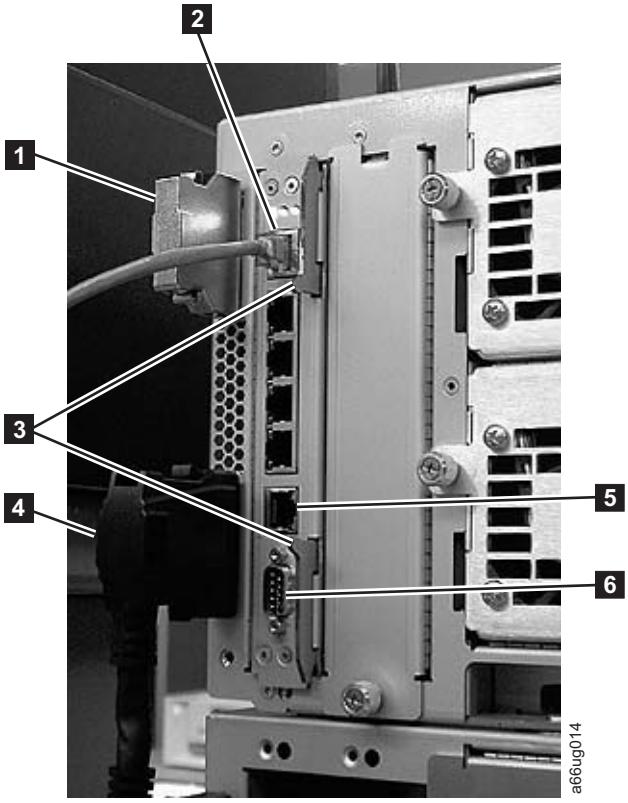

Figure 7-52. Library Control Blade (LCB)

1	Module communication terminator	4	Module-to-module communication cable
2	Ethernet cable (customer supplied)	5	Ethernet port (for IBM service personnel use)
3	Latches	6	Serial port (for IBM service personnel use)

3. Reconnect the Ethernet cable (2 in Figure 7-52) by pinching the tab and pushing the connector into the LCB.

   Note: Six slots reside below the Ethernet cable. The four topmost slots are reserved for future use. The two bottommost slots are designated as Ethernet (5 in Figure 7-52) and serial (6 in Figure 7-52) ports, and are reserved for use by IBM Service Personnel.
4. Power ON the library and wait for it to initialize. This may take from 2 to 10 minutes, depending on the level of firmware on the Library. If the Compact Flash Card is new and has never been initialized, see "Upgrading the Compact Flash Card Firmware."
5. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Upgrading the Compact Flash Card Firmware

If the Compact Flash Card is new and has never been initialized, it contains a minimal level of library firmware which allows the library to boot up and display an Upgrade Notification message. In order to use the library, you must upgrade to the latest level of library firmware. Use the following steps to upgrade firmware the first time you use a new Compact Flash Card.

1. Log on to the local operator panel as ADMIN. The "Network Configuration" screen will appear.
2. Turn OFF the DHCP selection.
3. Enter the IP Address, Subnet Mask, and Default Gateway selections.
4. Verify the Library Name selection.
5. Select Apply.
6. When the SUCCESS message appears, select CANCEL. This will log OFF from the local operator panel.
7. Log ON to the remote web browser as ADMIN. The Upgrade Notification message should display on the web console.
8. Click on the upgrade firmware link provided, then browse to locate the firmware file. See “Updating Library Firmware” on page 6-26 for detailed instructions.
9. Restore the system configuration data to the compact flash card: See Appendix E of the TS3310 Setup and Operator Guide.

Power Supply (Primary and Redundant)

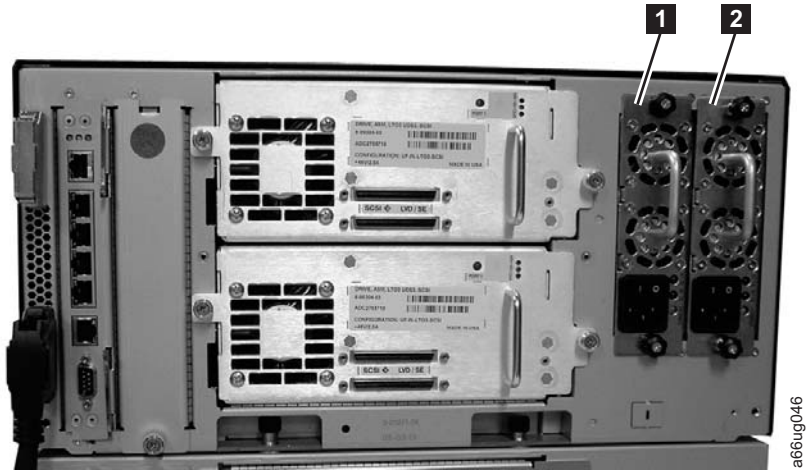

Figure 7-53. Power supplies in a control module

1 Primary power supply **2** Redundant power supply

Library power is controlled at the individual power supplies and at the front panel of the library. The switch on the rear of each power supply controls power for the module in which the power supply is installed. The button on the front of the control module controls power for all library modules in the library.

A second (redundant) power supply helps ensure that your library does not lose power (and become inaccessible) if the primary power supply should happen to fail. The library automatically switches to the redundant power supply if the primary power supply fails for any reason.

A redundant power supply should be connected to a different AC circuit from the primary power supply. Even better, the redundant power supply should be connected to a separate power distribution source. In the event that the primary power supply fails or becomes unstable, the redundant power supply will automatically power the library as long as it is turned ON.

If your library has a redundant power supply, you can replace the primary power supply without powering OFF the library. If your library does not have a redundant power supply installed, the empty slot will be covered by a metal plate.

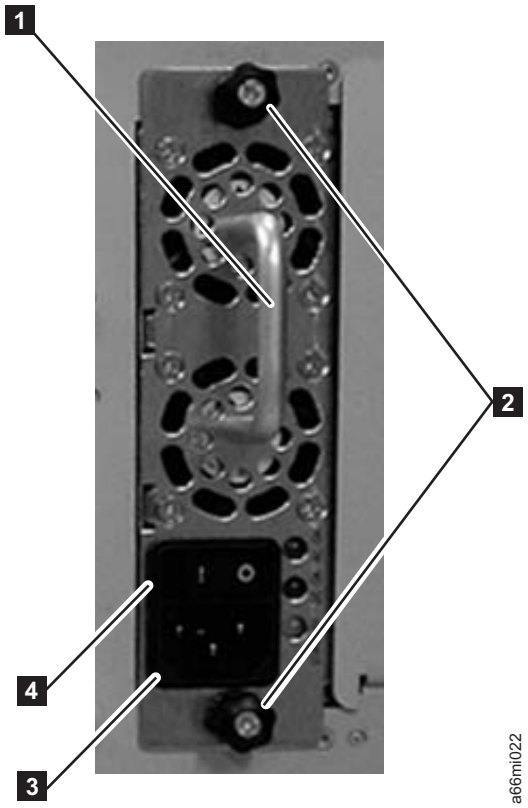

Figure 7-54. Power Supply

1	Handle	3	Power cord receptacle
2	Thumb screws	4	Power switch

Removing a Primary Power Supply

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.

   Note: It is not necessary to power off the library if there is a redundant power supply installed.

2. Unplug each end of the power cord in the proper sequence.

   Attention: First, disconnect the power cord from the power source. Then, disconnect the power cord from the power supply receptacle (3 in Figure 7-54).

3. Loosen the two thumb screws (2 in Figure 7-54) by turning them counterclockwise.
4. Grasp the handle (1 in Figure 7-54) and slowly pull the power supply toward you, while supporting it from underneath.
5. Install a metal cover plate over the vacant power supply slot if you are not immediately installing a replacement.

Reinstalling/Replacing a Power Supply

1. Grasp the power supply handle (1 in Figure 7-54 on page 7-52) while supporting it from underneath. Then, line up the power supply with the guides in the slot, and carefully push the power supply into the library.
2. Tighten the two thumb screws (2 in Figure 7-54 on page 7-52) on the power supply by turning them clockwise.
3. Connect the power supply by plugging in each end of the power cord in the proper sequence.

   Attention: First, connect the power cord to the power supply component (3 in Figure 7-54 on page 7-52). Then, connect the power cord to the power source.
4. Toggle the power switch (4 in Figure 7-54 on page 7-52) on the power supply to the I (ON) position.
5. If there is no redundant power supply, power ON the library using the power button on the front of the machine.

Removing a Redundant Power Supply

1. Locate the slot for the redundant power supply to be removed on the back of the library.
2. Toggle the redundant power supply power switch (4 in Figure 7-54 on page 7-52) to the **O** (OFF) position.
3. Unplug the power cord from the redundant power supply receptacle (3 in Figure 7-54 on page 7-52).
4. Loosen the two thumb screws (2 in Figure 7-54 on page 7-52) by turning them counterclockwise.
5. Grasp the handle (1 in Figure 7-54 on page 7-52) and pull the power supply toward you. Support the component from underneath with your other hand.
6. Install a metal cover plate over the vacant redundant power supply slot if you are not immediately installing a replacement.

Replacing a Redundant Power Supply

1. Locate the slot for the redundant power supply on the back of the library module.
2. Remove the cover plate over the vacant redundant power supply slot, if necessary.
3. Insert the redundant power supply by gripping the handle (1 in Figure 7-54 on page 7-52), sliding it into the guide slots, and pushing it into the empty slot.
4. Tighten the two thumb screws (2 in Figure 7-54 on page 7-52) that hold the redundant power supply in place.
5. Connect the power cord to the power supply (3 in Figure 7-54 on page 7-52) and to its source.
6. Turn ON power to the redundant power supply, using the switch (4 in Figure 7-54 on page 7-52) on the power supply.

Internal Components

The library has the following internal components:

- Y-axis/Picker Assembly
- Picker Assembly
- Y Motor Assembly
- M2 Robot Assembly
- M2 Picker Assembly

- Storage Column
- Cable Spool
- Gear Rack
- Internal Cables/Boards
- Drive Power Fuse

Y-axis/Picker Assembly

The Y-axis/Picker Assembly houses the Y Motor and moves the Picker and Bar Code Scanner within the library.

Removing the Y-axis/Picker Assembly

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Remove the Control Module from the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
3. Remove the top cover of the control module, if necessary.
4. Open the I/O Station door then the Access Door to access the Y-axis/Picker Assembly.
5. Optionally, remove the I/O Station from the control module for easier access.

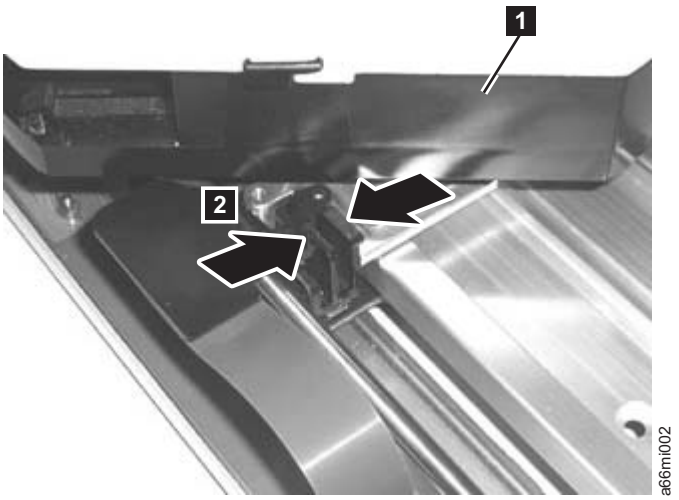

Figure 7-55. Flat cable connector

6. Raise the Y-axis/Picker Assembly to the top of the library and carefully lift it out. Be careful not to damage the Cable Spool flat cable (**2** in Figure 7-56 on page 7-55). Set the Y-axis/Picker Assembly on top of the control module and loosen the thumbscrew (**1** in Figure 7-56 on page 7-55) to disconnect the cable spool.

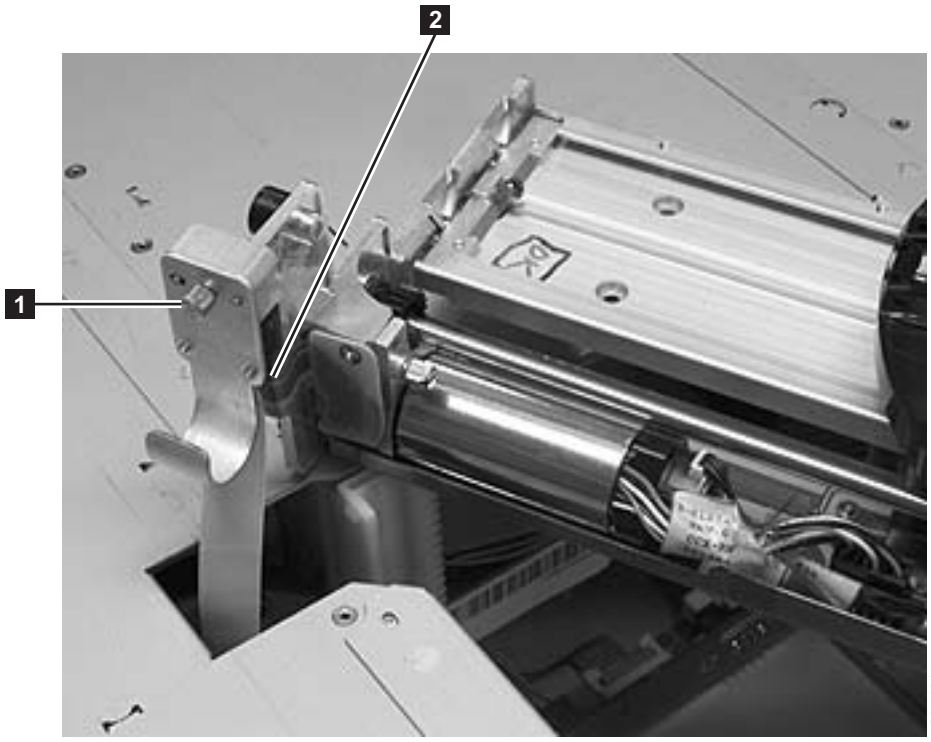

Figure 7-56. Thumb screw securing cable spool

7. Carefully lower the Cable Spool connector (**1** in Figure 7-57 on page 7-56) and hook it around the black plastic guide peg (**2** in Figure 7-57 on page 7-56).

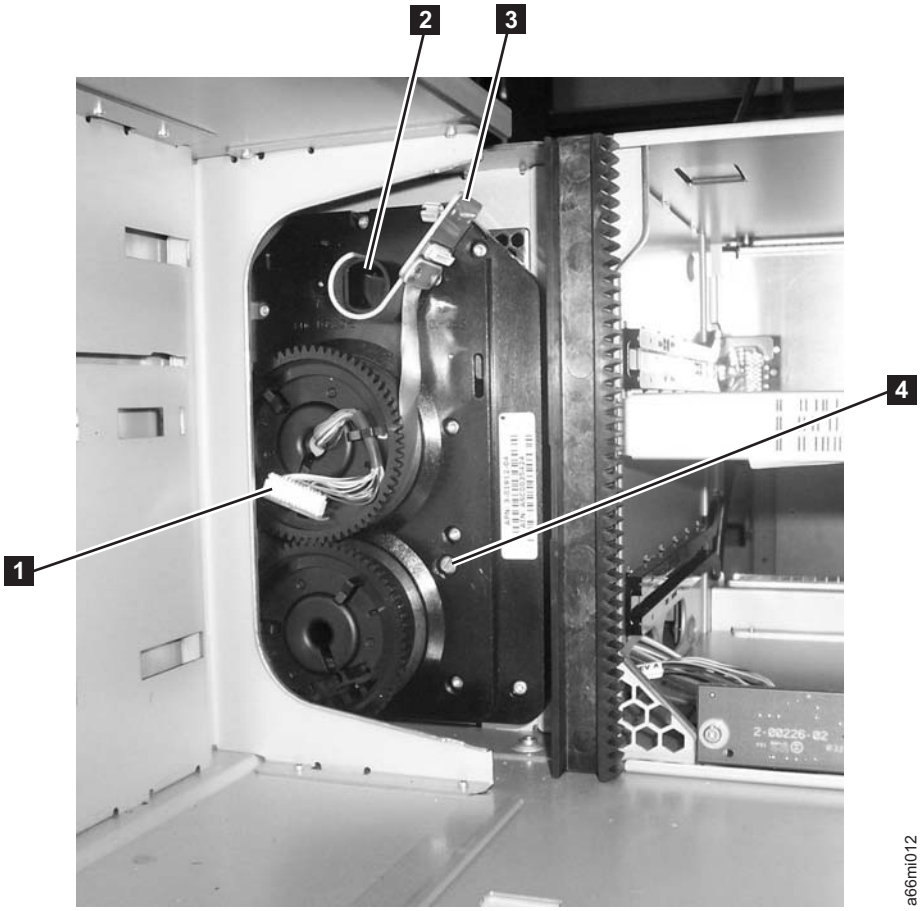

Figure 7-57. Cable Spool (with storage columns removed)

Replacing the Y-axis/Picker Assembly

1. Ensure all gear racks are properly positioned and that they contain NO GAPS between units in the library.
2. Set the Y-axis/Picker Assembly on top of the control module as shown in Figure 7-56 on page 7-55.
3. Remove the Cable Spool connector (**3** in Figure 7-57) from the black plastic peg (**2** in Figure 7-57).
4. Carefully lift the Cable Spool connector.
5. Tighten the thumb screw to connect the spooler cable to the Y-axis/Picker Assembly (**1** in Figure 7-56 on page 7-55).
6. **Lower the Y-axis/Picker Assembly by tilting its gears at a 45° angle onto the top of the front and rear gear racks (see Figure 7-58 on page 7-57and Figure 7-59 on page 7-58). BE VERY CAREFUL TO START BOTH Y-AXIS/PICKER ASSEMBLY GEARS TOGETHER TO ENSURE THE Y-AXIS/PICKER ASSEMBLY IS LEVEL. After lowering the Y-axis/Picker Assembly a few teeth, verify that the Y-axis/Picker Assembly is level with the library chassis. If it is not level, remove the Y-axis/Picker Assembly and reinsert.**

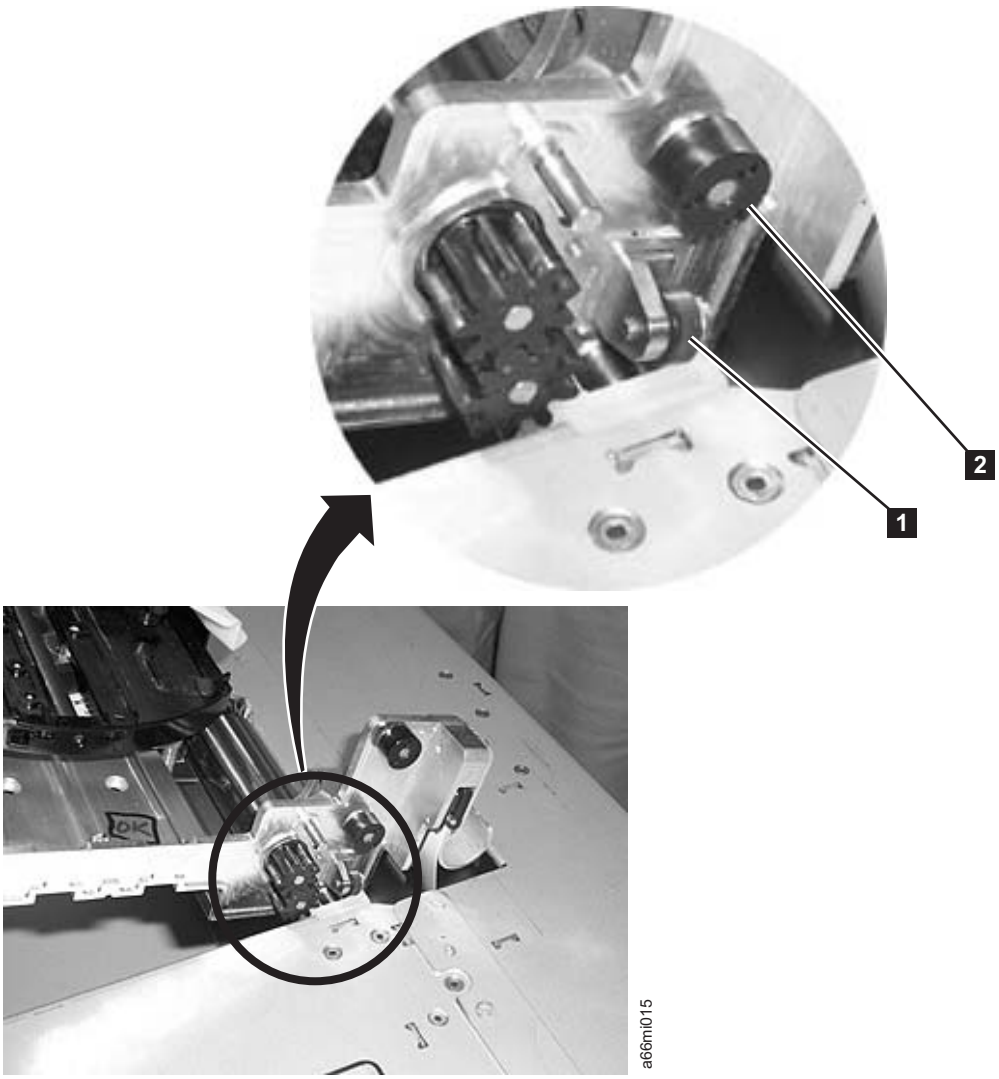

Figure 7-58. Guide rollers on Y-axis/Picker Assembly

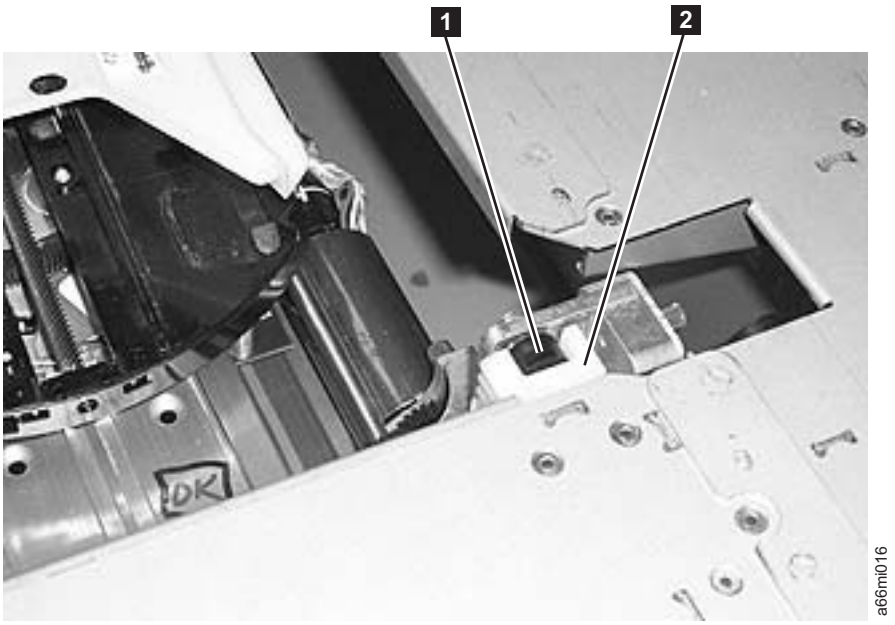

Figure 7-59. Y-axis/Picker Assembly rollers inserted in gear rack track

7. Replace the I/O Station (see "Reinstalling an I/O Station" on page 7-35).
8. Close the Access Door then the I/O Station door.
9. Replace the top cover of the control module, if necessary.
10. Replace the Control Module in the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
11. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Original Picker Assembly

The Picker moves media to and from storage slots and tape drives and positions the Bar Code Scanner to enable it to read bar code labels on cartridges and fiducials on cartridge magazines and tape drives. The Picker Assembly can be removed through the top of the library (recommended method) or through an Access Door opening in the library.

Removing the Picker Assembly from the Y-axis Assembly in a Stand-alone Library

1. If necessary, vary all drives offline, then power OFF the library.
2. Remove the top cover of the library.
3. Open the I/O Station door then the Access Door to access the Y-axis/Picker Assembly.
4. Optionally, remove the I/O Station from the expansion unit for easier access.
5. Facing the library, rotate the Picker Assembly until the front of the Picker Assembly is oriented approximately 45 degrees right of center, as seen from the top of the library, to access the flat cable connector (**1** in Figure 7-60 on page 7-59).

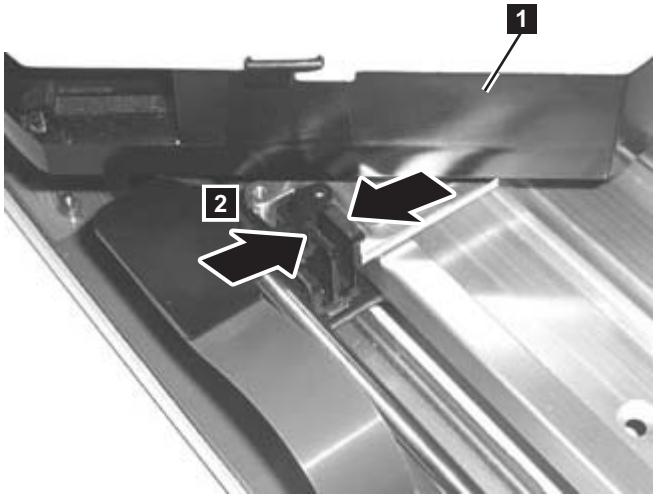

Figure 7-60. Flat cable connector

6. Pinch the top of the connector (**2** in Figure 7-60) and lift up to disconnect it.
7. Loosen the front and rear thumb screws (**1** in Figure 7-61.

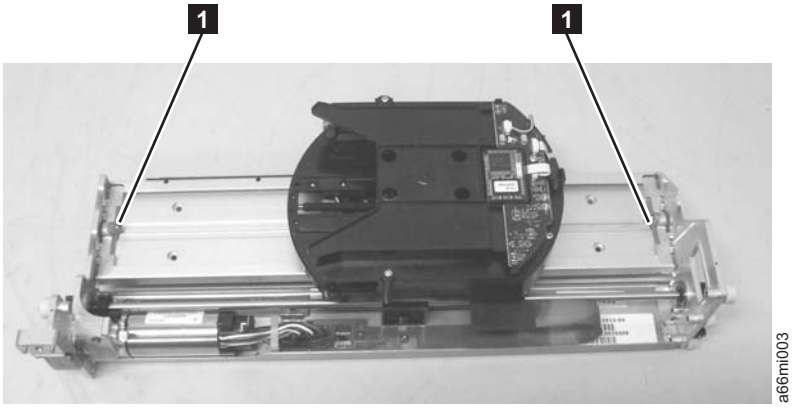

Figure 7-61. Thumb screws

8. Carefully lift the Picker Assembly and remove it through the top of the library.

Replacing the Picker Assembly on the Y-axis Assembly in a Stand-alone Library

1. Carefully insert the Picker Assembly and replace it through the top of the library.
2. Tighten the front and rear thumb screws (**1** in Figure 7-61).
3. Facing the library, rotate the Picker until the front of the Picker Assembly is oriented approximately 45 degrees right of center, as seen from the top of the library, to access the flat cable connector (**1** in Figure 7-60).
4. Pinch the top of the connector (**2** in Figure 7-60).
5. Close the front door(s).
6. Replace the I/O Station.
7. Replace the top cover of the library.
8. Power ON the library.
9. Remove any media that is in the picker.

Removing the Picker from the Y-axis Assembly in a Rack-mounted Library

Tool Required:

- Flashlight

1. If necessary, remove the I/O Station(s) from the library.
2. Open the Access Door(s).
3. Reach through the Access Door and loosen the screws (**1** in Figure 7-61 on page 7-59) on the front and rear of the Picker Assembly.
4. Rotate the Picker Assembly with the grippers pointing toward 11 o'clock (**1** in Figure 7-60 on page 7-59) to expose the flat cable connector.
5. Pinch the top of the connector (**2** in Figure 7-60 on page 7-59) and lift up to disconnect it.
6. Unplug and move the connector to the side of the Picker Assembly.
7. Move the Picker Assembly back to its normal position.
8. Lift the Picker Assembly, tilt it with the left side up, and carefully remove through the Access Door opening. Try to keep the Picker Assembly toward the top of the opening to prevent damaging the board underneath the assembly.
9. Remove any media that is in the picker.

Replacing the Picker Assembly on the Y-axis Assembly in a Rack-mounted Library

1. Lift the Picker Assembly, tilt it with the left side up, and carefully insert it into the library through the Access Door opening. Try to keep the assembly toward the top of the opening to prevent damaging the board underneath the Picker Assembly.
2. Position Picker Assembly on the Y-axis Assembly with the larger extension of the Picker Assembly board to the right when facing the library from the front.
3. Reach through the I/O Station door and tighten the screws (**1** in Figure 7-61 on page 7-59) on the front and rear of the Picker Assembly.
4. Rotate the Picker Assembly with the grippers pointing toward 11 o'clock (**1** in Figure 7-60 on page 7-59) to expose the flat cable connector.
5. Plug in the connector (**2** in Figure 7-60 on page 7-59).
6. Move the Picker Assembly back to its normal position.
7. Close the Access Door(s).
8. Return the I/O Station flap to its normal position.
9. If necessary, replace the I/O Station(s) in the library.

Y Motor

The Y Motor controls movement of the Y-axis Assembly, Picker, and Bar Code Scanner in the Y-axis.

Removing the Y Motor from the Y-Axis/Picker Assembly in a Stand-alone Library

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Remove the Y-axis/Picker Assembly first. Place the Y-axis/Picker Assembly on a flat work surface.
3. Disengage the cable retention clip.
4. Remove the large black connector. See Figure 7-62 on page 7-61.
   a. Pinch the latch (**1** in Figure 7-62 on page 7-61) on the cable connector.

b. Carefully lift up on the connector.

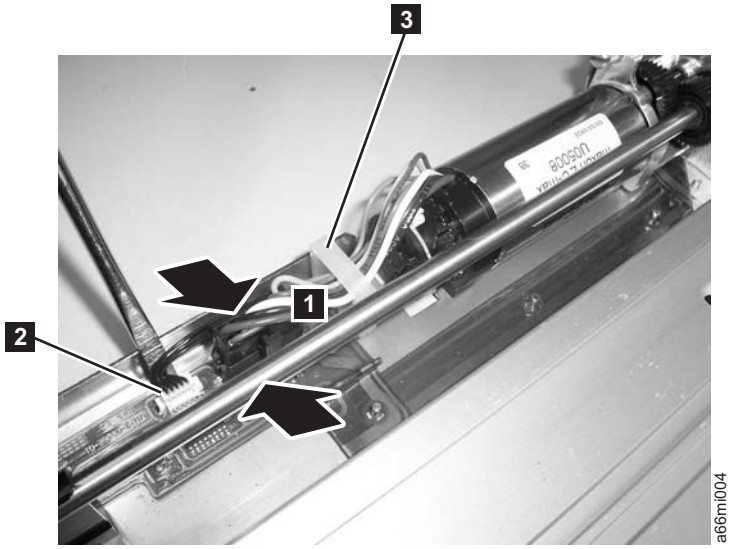

Figure 7-62. Y motor connector

5. Use a small flat blade screw driver to pry up on the small white connector (**2** in Figure 7-63) gently working the screw driver blade along the entire outside edge of the connector.

   Important: Be very careful not to damage the connector.

6. Loosen the thumb screw (**1** in Figure 7-63), slide the motor to the left, then lift the motor out of the Robot Assembly (**2** in Figure 7-63).

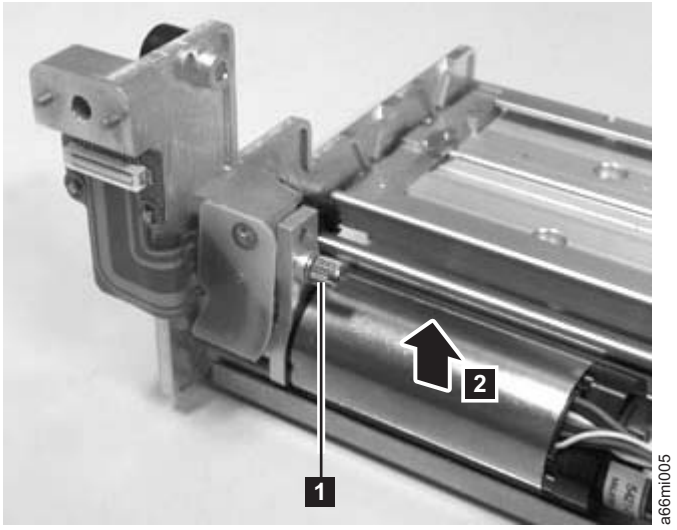

Figure 7-63. Y motor thumb screw

Replacing the Y Motor in the Y-axis/Picker Assembly in a Stand-alone Library

1. Ensure that the black plastic piece on the wiring end of the motor (**1** in Figure 7-64 on page 7-62) fits into the slot in the base plate (**2** in Figure 7-64 on page 7-62

on page 7-62).

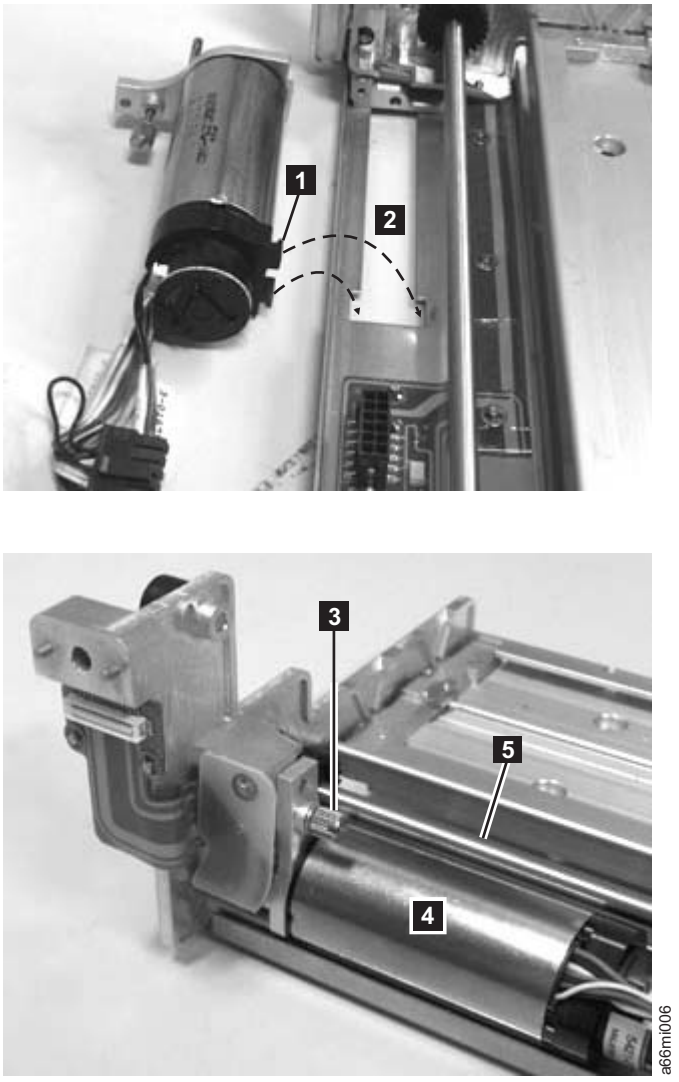

Figure 7-64. Correct Y motor position

Note: The top of the motor (4 in Figure 7-64) must be parallel with the Picker guide rod (5 in Figure 7-64).

2. Install the Y Motor in the Y-axis/Picker Assembly and tighten the thumb screw. The small gear on the Y Motor must connect with the larger gear on the Y-axis/Picker Assembly.
3. Connect the small white connector (2 in Figure 7-65 on page 7-63).

   Important: Be very careful not to damage the connector.
4. Connect the large black connector. See Figure 7-65 on page 7-63.

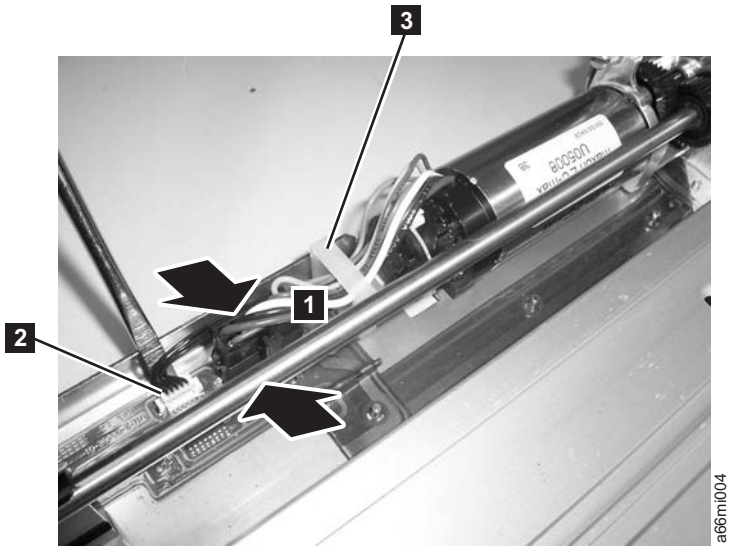

Figure 7-65. Y motor connector

a. Pinch the latch on the cable connector (**1** in Figure 7-65).
b. Carefully plug in the connector.

5. Engage the cable retention clip.
6. Replace the Y-axis/Picker Assembly.
7. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing the Y Motor from the Y-axis/Picker Assembly in a Rack-mounted Library

Tools Required:

- Flashlight
- Small flat blade screwdriver

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Remove the Control Module from the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
3. Remove the Y-axis/Picker Assembly.
4. Disengage the cable retention clip.
5. See Figure 7-66 on page 7-64. Remove the large black connector.
   a. Pinch the latch (**1** in Figure 7-66 on page 7-64) on the cable connector.
   b. Carefully lift up on the connector.

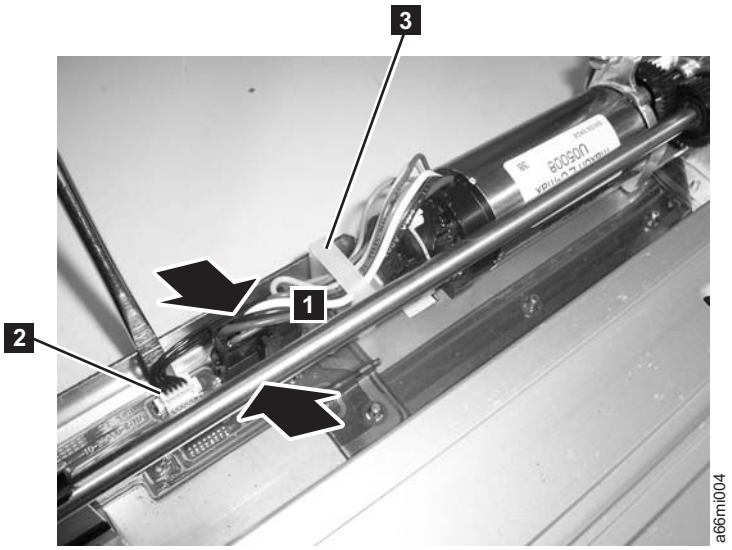

Figure 7-66. Y motor connector

6. Use a small flat blade screw driver to pry up the small white connector (**2** in Figure 7-66) gently working the screw driver blade along the entire outside edge of the connector.

   Important: Be very careful not to damage the connector.
7. Disengage the cable retention strap.
8. Using the screwdriver, lift the latch on the black connector then unplug the cable.
9. Loosen the thumb screw (**1** in Figure 7-67).

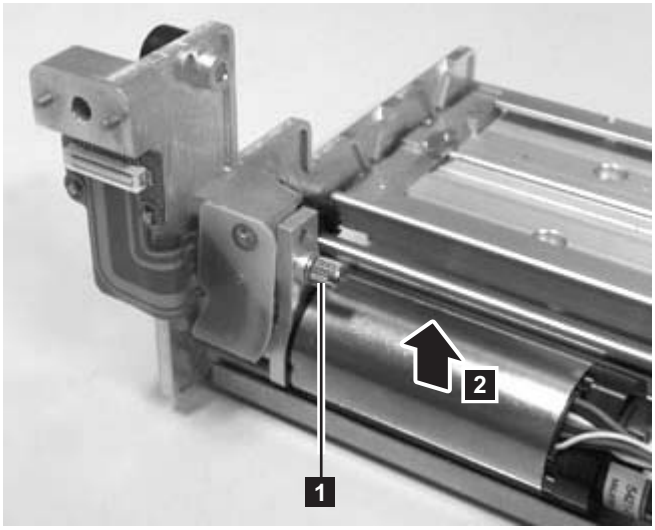

Figure 7-67. Y motor thumb screw

10. Tilt the Y Motor to the left and remove from the Y-axis/Picker Assembly (**2** in Figure 7-67).

Replacing the Y Motor on the Y-axis/Picker Assembly in a Rack-mounted Library

Tools Required:

- Flashlight
- Small flat blade screwdriver

1. Ensure that the black plastic piece on the wiring end of the motor (1 in Figure 7-68) fits into the slot in the base plate (2 in Figure 7-68). When the thumb screw (3 in Figure 7-68) is tightened, the top of the motor

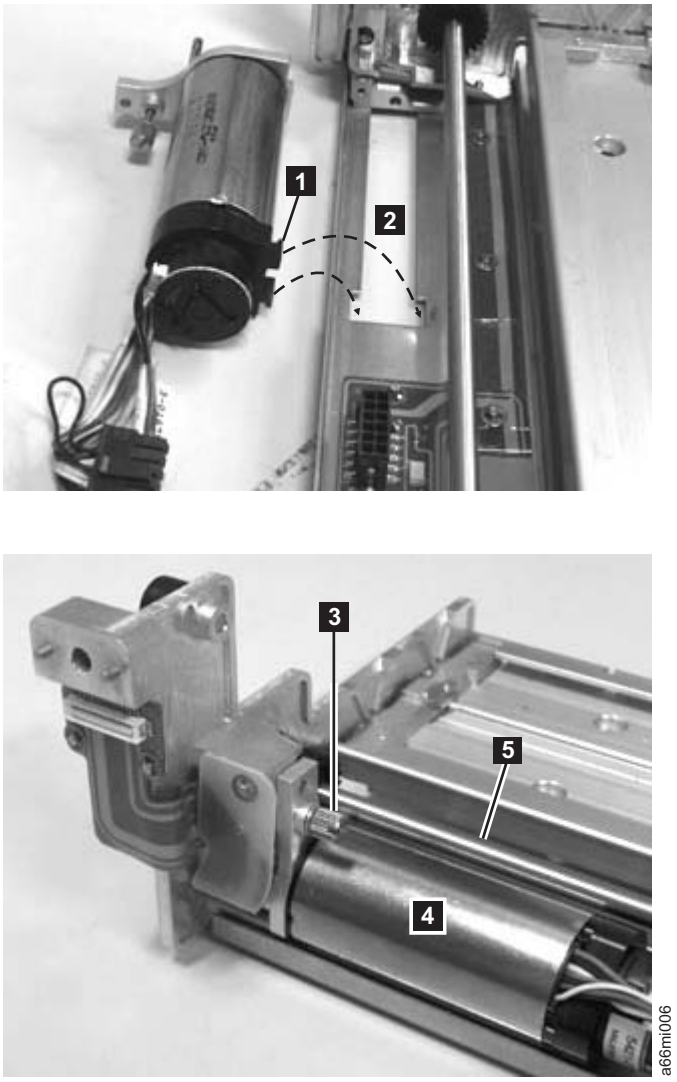

Figure 7-68. Correct Y motor position

(4 in Figure 7-68) must be parallel with the Picker guide rod (5 in Figure 7-68).

2. Install the Y Motor in the Y-axis/Picker Assembly and tighten the thumb screw. The small gear on the Y Motor must connect with the larger gear on the Y-axis/Picker Assembly.
3. Connect the small white connector (2 in Figure 7-69 on page 7-66).

   Important: Be very careful not to damage the connector.

4. Connect the large black connector. See Figure 7-69.

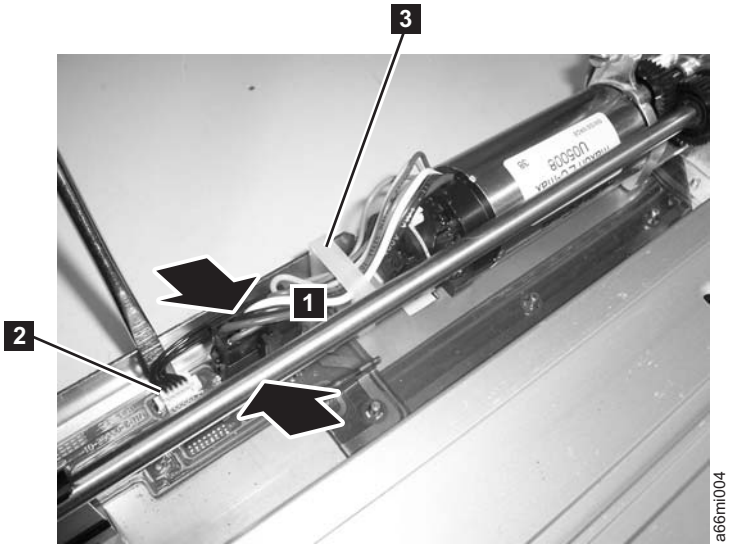

Figure 7-69. Y motor connector

   a. Pinch the latch on the cable connector (**1** in Figure 7-69).
   b. Carefully plug in the connector.
5. Engage the cable retention clip.
6. Replace the Robot Assembly.
7. Replace the Control Module in the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
8. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

FRU Replacement Strategy For Model 1 and Model 2 Robots

Model 1 Robot

You receive either a picker assembly FRU or a Y-carriage assembly FRU, or both. You may replace one or the other, or you may build them into a complete robot assembly and replace it as a single unit.

Model 2 Robot

You receive either a complete robot assembly FRU, or a picker assembly FRU. You either replace the entire robot assembly as a single unit (requires access through the top of the library), or you replace just the picker assembly (can be accessed through the front access door of the library).

Removing the Model 1 Robot Assembly from the Library

Required tools:

- Phillips #2 screwdriver, for removing and replacing the top cover plate
- T10 TORX screwdriver, for loosening and tightening the thumbscrew that attaches the cable spool clip to the robot assembly

1. Power off the library. When the library is powered off, the robot assembly slowly falls to rest in the bottom module of the library.
2. Park the robot assembly in the control module. If the library is a single control module, skip this step.

a. Open the I/O station and access doors of each module.
b. Using your hands, gently lift the robot assembly into the control module. The robot assembly should glide slowly and with some resistance.

   CAUTION:
   Support the robot assembly by holding onto the broad metal X-axis base plate. Lifting the robot by the thin metal rod will bend the rod. Lifting the robot by the black plastic picker body can damage the robot.
c. After raising the robot assembly to the approximate middle of the control module, hold it in place with one hand and, using your other hand, move the parking tab to the "parked" position (**Model 1 parking tab**: swivel toward you). The metal parking tab is located at the bottom of column 1.
d. Gently release the robot assembly to rest on the parking tab.

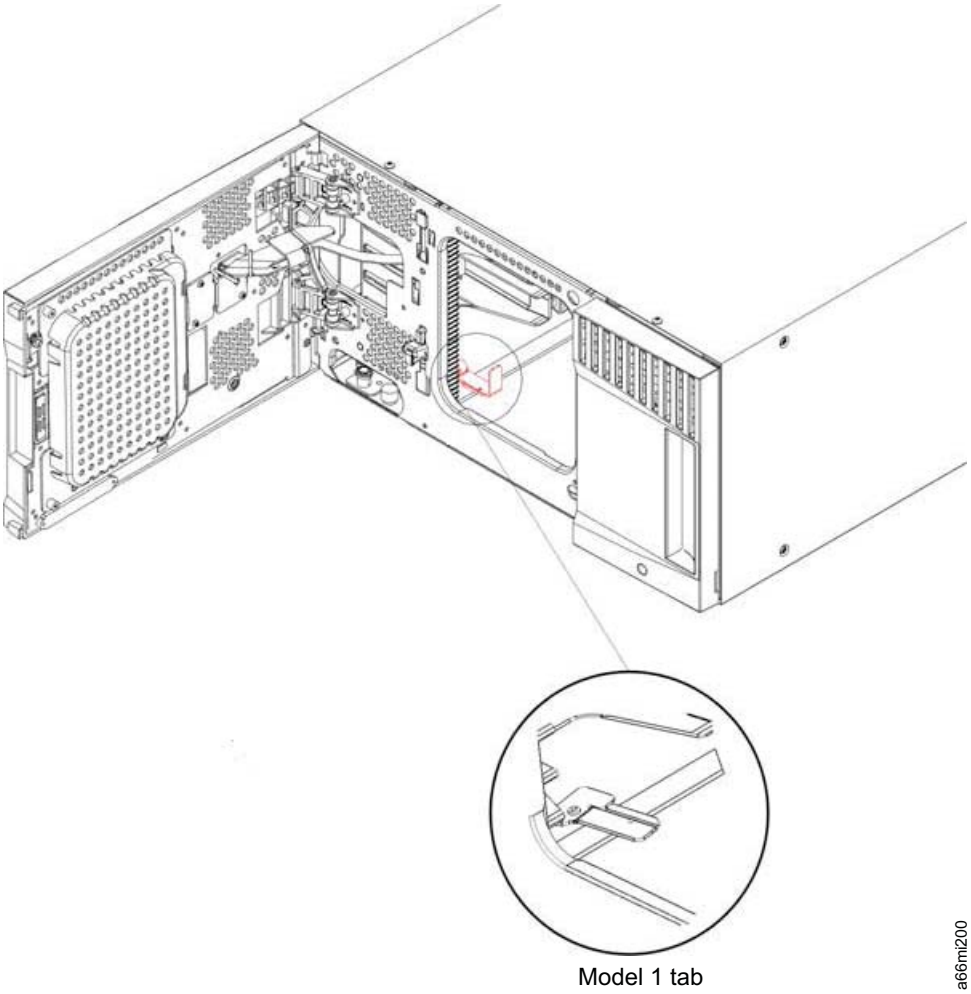

Figure 7-70. Robot Assembly: Parking tab

3. Unstack the control module from the library.

   Note: You can skip this step if:
   - There are no expansion modules stacked on the control module, *and*
   - There are 12 inches of clearance above the control module.

a. Before removing the control module, you must first remove all expansion modules (if any) above the control module. See “Removing/Replacing an Expansion Module” on page 7-18

b. Remove the control module. See “Replacing a 5U Library (Control Module) in a Rack” on page 7-4

4. If the control module’s top cover plate is still in place, remove it. Use the Phillips screwdriver to loosen all screws to remove the cover.

   Note: On newer versions of the top cover, the screws are retained in the cover. Partially loosen all screws before completely loosening any one screw. Loosening one screw completely while the others are tight can cause the retaining clip of the screw being loosened to come off. In older versions of the top cover, remove the screws and set aside.

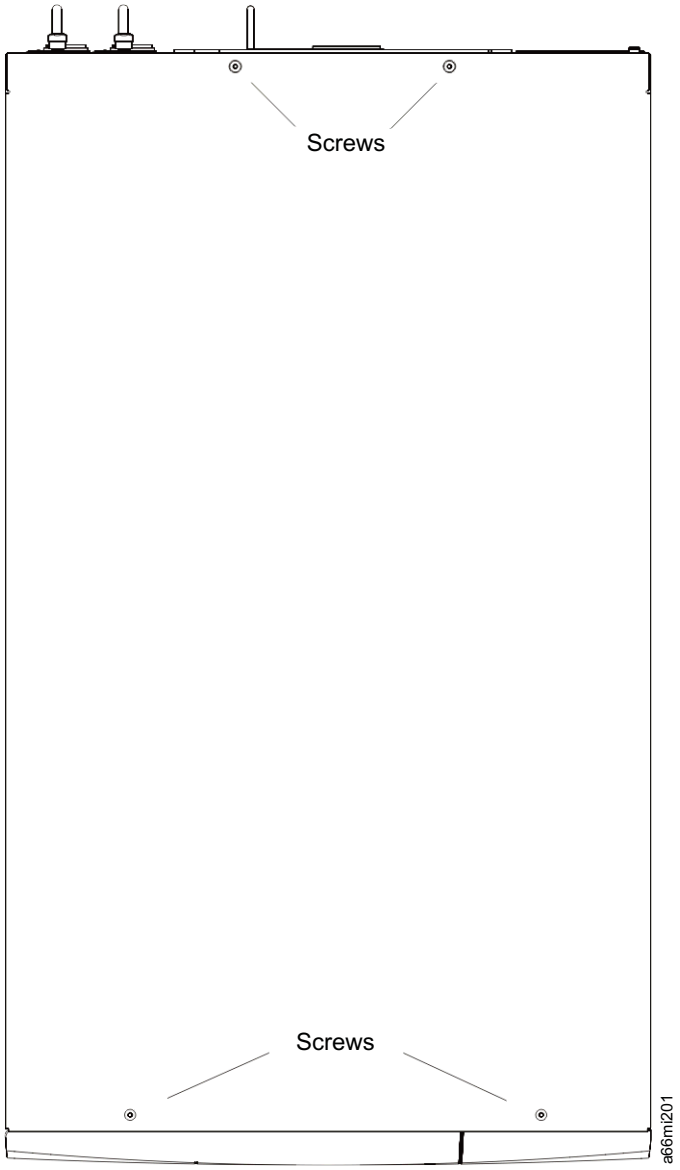

Figure 7-71. Screw placement

5. If the I/O station and access doors on the control module are not open, open them now. This makes it easier to access the robot.

6. Carefully grip the picker and pull it toward the front of the library.

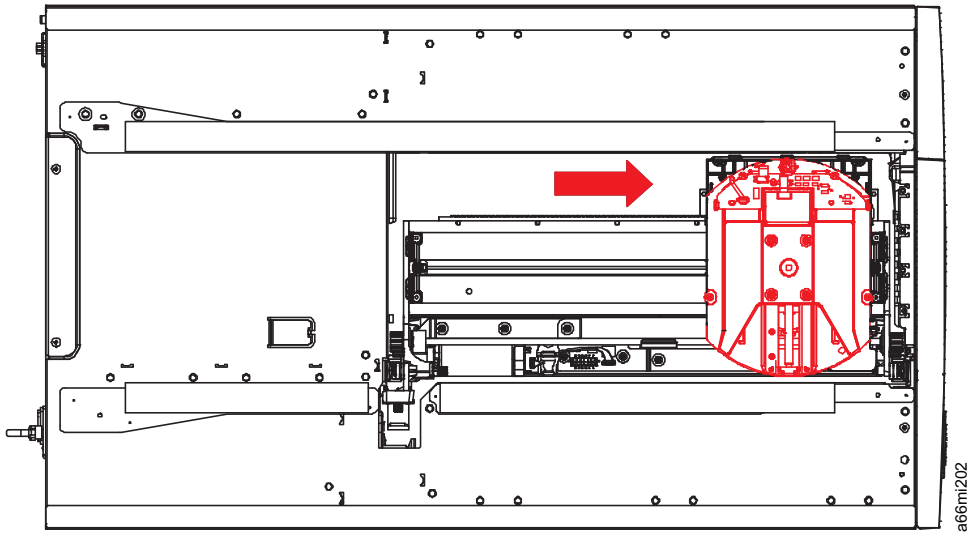

Figure 7-72. Pull Picker to the front of the library

7. Grip the robot in the center of the tray.
8. Carefully lift the robot out of the control module and place it at an angle on top of the control module. Be careful not to pinch the cable spool flex circuit.

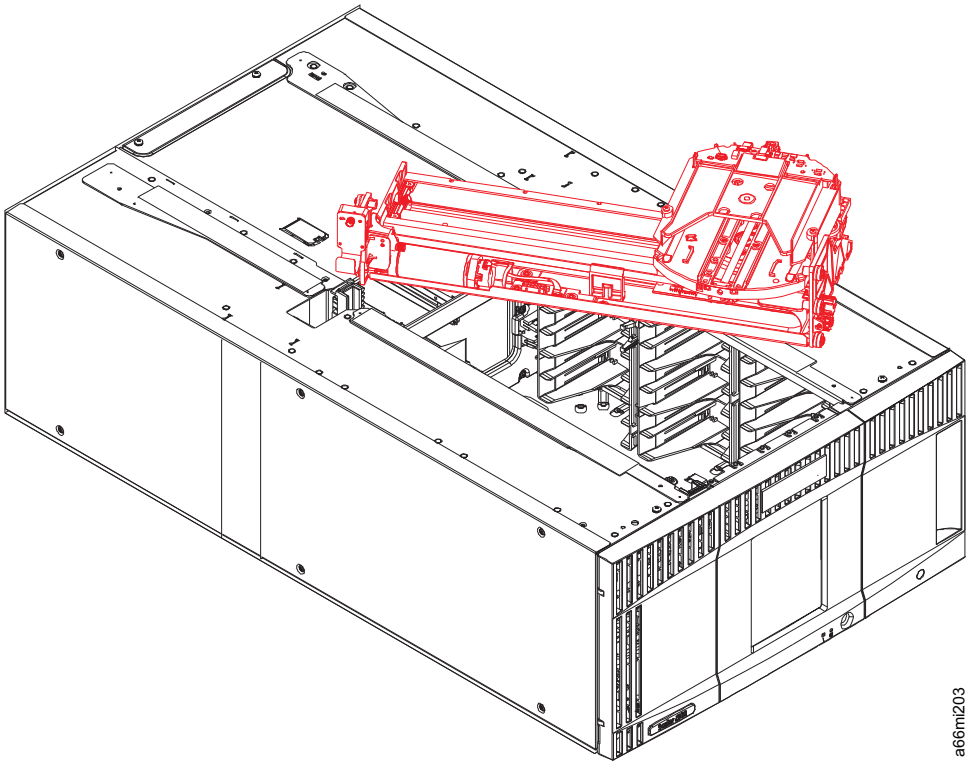

Figure 7-73. Lift Robot out of Control Module

9. Unscrew the captive thumbscrew that attaches the cable spool to the robot assembly, and pull the cable spool flex circuit off the assembly.

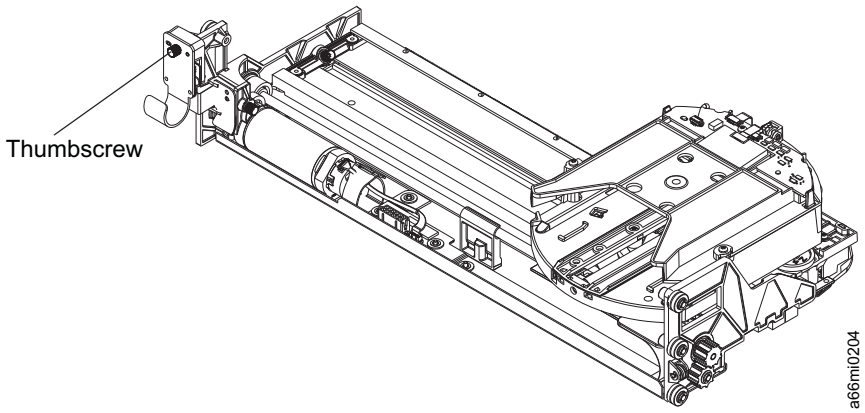

Figure 7-74. Cable Spool Flex Circuit

10. Lay the cable spool circuit across the library so that it rests on the edge. (This keeps it from falling inside.)

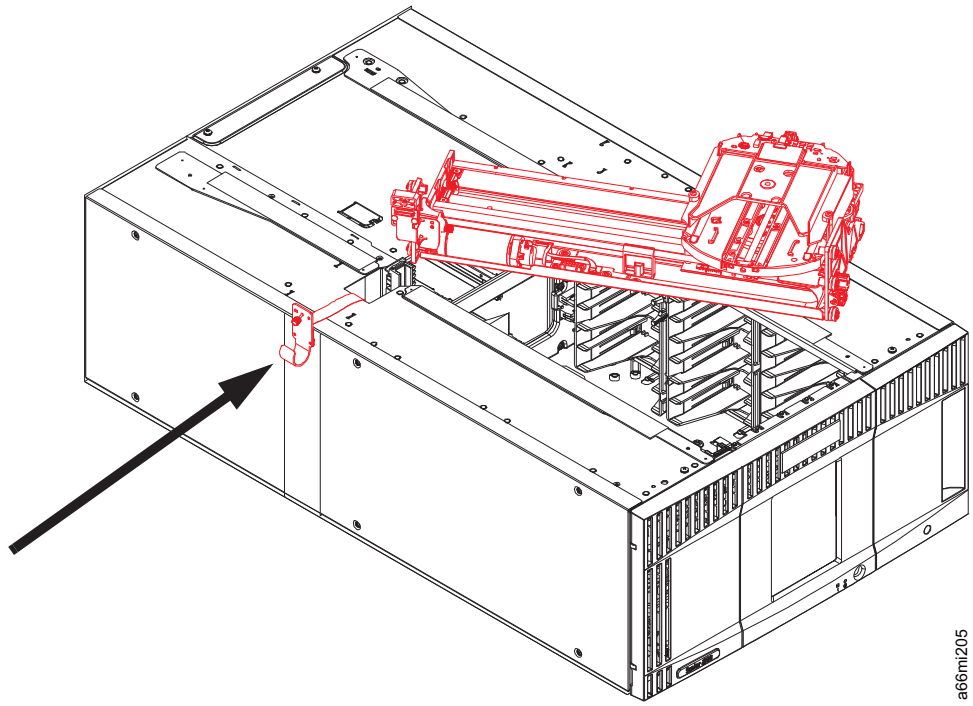

Figure 7-75. Robot Assembly: Parking tab

11. Perform any needed replacement or repairs, following the instructions in the appropriate sections of this manual. Then proceed to "Installing the Model 1 Robot Assembly in the Library"

Installing the Model 1 Robot Assembly in the Library

Required tools:

- Phillips #2 screwdriver, for removing and replacing the top cover plate

- T10 TORX screwdriver, for loosening and tightening the thumbscrew that attaches the cable spool clip to the robot assembly

1. Place the robot assembly on top of the control module at an angle as shown below. This position keeps the cable from kinking when you attach the cable spool in the next step.

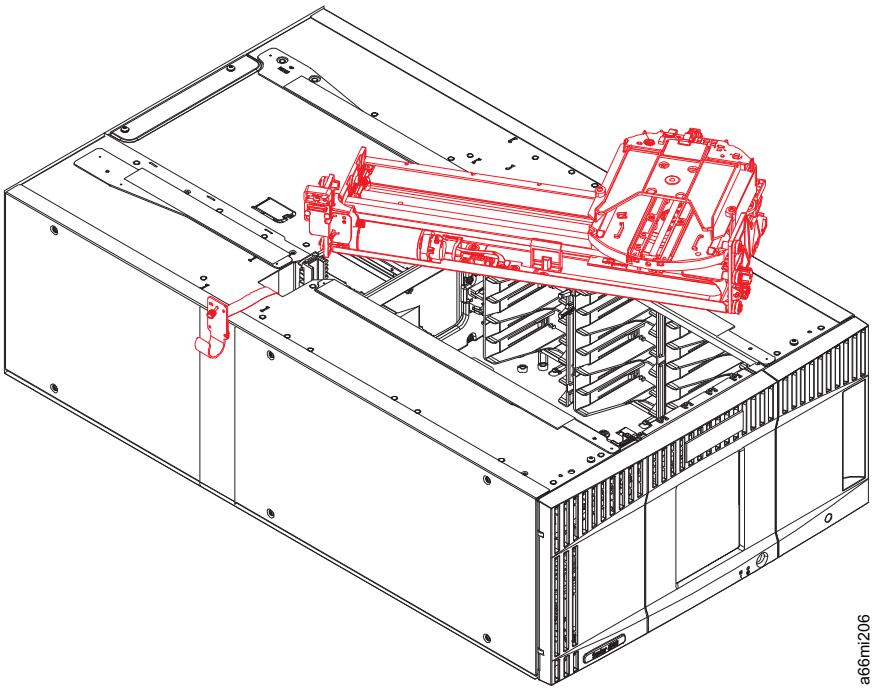

Figure 7-76. Robot Assembly on top of Control Module

2. Reattach the cable spool to the robot assembly, using the thumbscrew on the cable spool clip. Use the T10 TORX screwdriver to tighten the thumbscrew until the attached lock washers compress. Do not over-tighten as this could break the thumbscrew.
3. Lift the robot from the center of the tray and hold it at a 30-degree angle to the control module. Insert the front and rear lower guide rollers into the gear rack on the Y-rail, then lower the robot slightly until both the front and rear gears make contact with the gear rack.

   Note: It is very important to hold the robot at a 30-degree angle until both the front and rear gears contact the gear rack on the Y-rail.

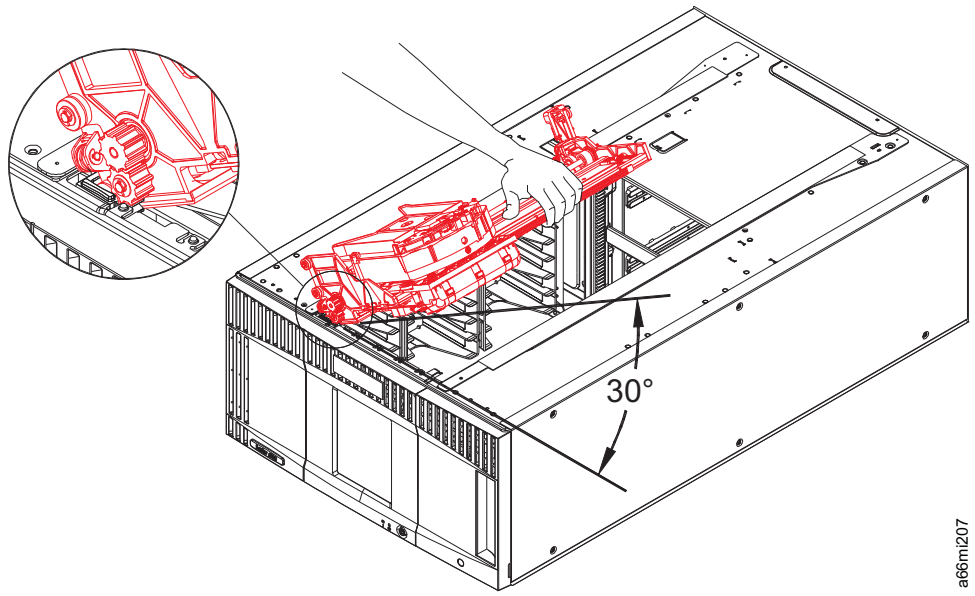

Figure 7-77. Lift the Robot at a 30-degree angle

4. Rotate the robot so that it is level with the library. Do not allow either the front or rear lower guide rollers to exit the gear rack on the Y-rail. As you rotate the robot into the level position, the gears will rotate and engage in the gear rack.

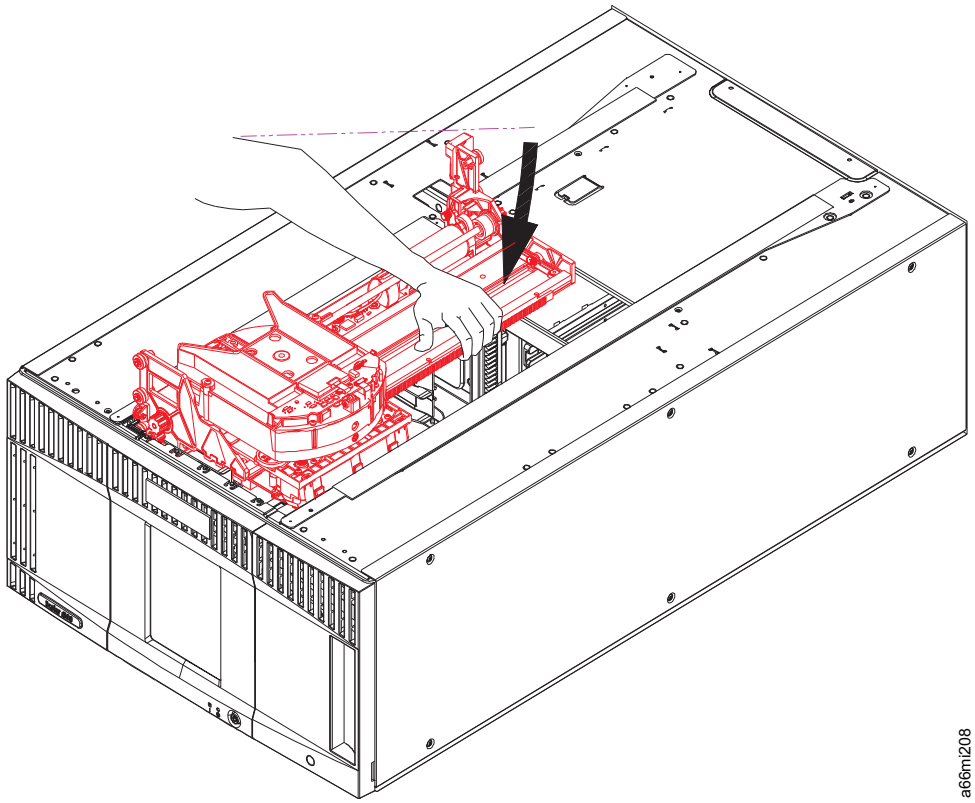

Figure 7-78. Rotate the Robot

5. While supporting the center of the robot tray, slowly lower the robot until the top of the Y climber front shelf mount is even with the front gear rack on the Y-rail. You may need to exert slight downward pressure on the robot to engage the gears in the gear rack and begin lowering the robot. While continuing to hold the robot level, verify that the Y climber rear shelf mount is level with the rear gear rack on the Y-rail. Check both places indicated in the figure below. If it is level, continue to the next step. ***If it is off by more than 2mm, the robot is NOT LEVEL. Disengage the robot from the gear rack and repeat the previous step.***

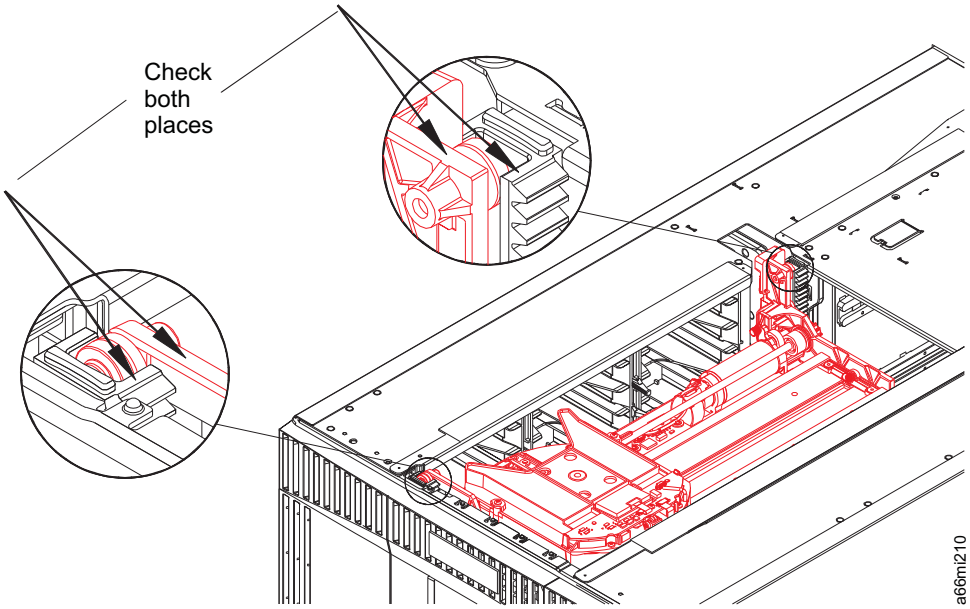

Figure 7-79. Lowering the robot

6. Once you have verified that the front and rear shelf mounts are level with the Y racks, then lower the robot so that it rests on the parking tab. (If your library consists of a single control module, release the robot so that it rests on the bottom of the unit.
7. Replace the top cover.
8. Re-stack the library modules as necessary.

   Note: If your library is rackmounted, you will need to perform additional steps to add the modules to the rack.
9. Unpark the robot assembly. (If your library consists of a single control module, skip this step.)
   a. Gently raise the robot assembly so that it no loner rests on the parking tab.

      CAUTION:
      Support the robot assembly by holding onto the broad metal X-axis base plate. Lifting the robot by the thin metal rod will bend the rod. Lifting the robot by the black plastic picker body can damage the robot.
   b. With your free hand, move the parking tab to the "unparked" position so that it is removed completely from the interior of the module (swivel the parking tab away from you). When replaced correctly, the parking tab will not accidentally swivel into the path of the robot.

c. Gently release the robot assembly. It will lower to the bottom module of the library.

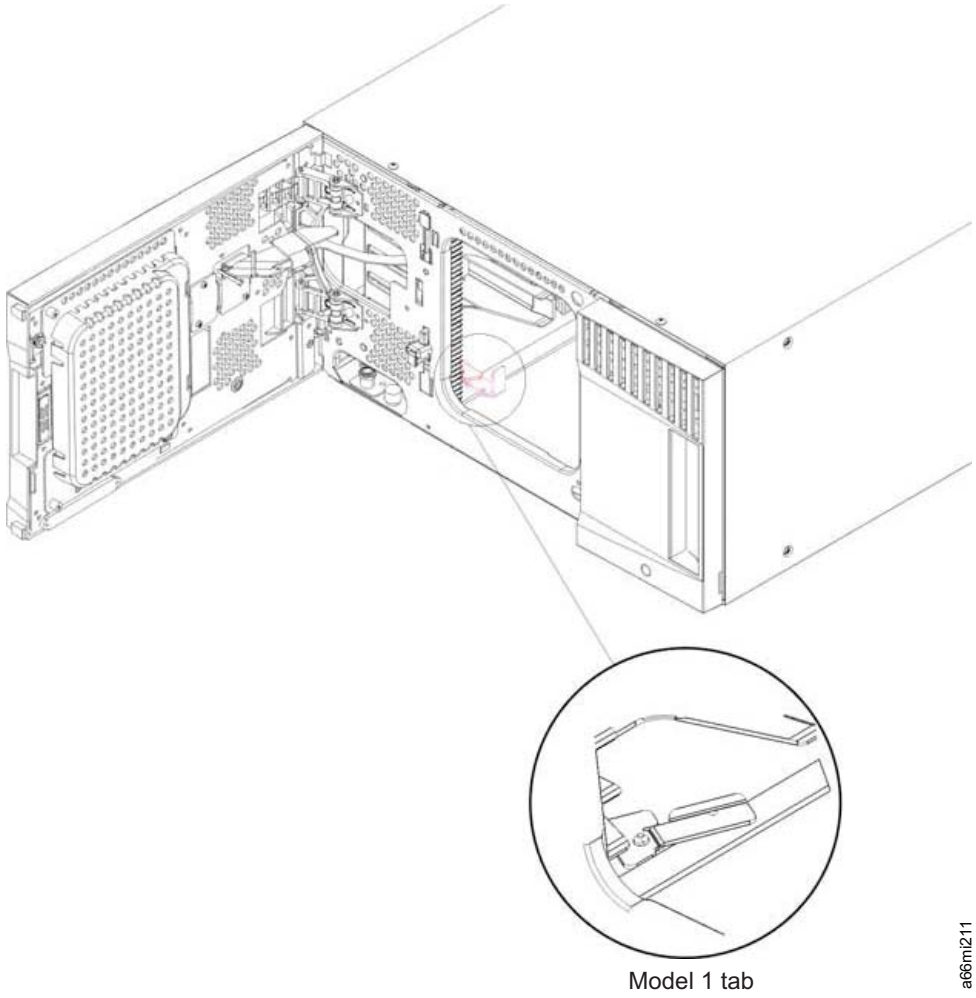

Figure 7-80. Parking tab to unparked position

10. Close the library's I/O station and access doors.
11. Power on the library.

Removing and Replacing the Model 1 Picker Assembly from the Y-Carriage Assembly Inside the Library

The picker is the robotic device with mechanical "fingers" that open and close to handle data cartridges inside the library. The picker is housed in the control module, though it can traverse up and down the entire length of the library.

When the library is powered off, the picker rests in the bottom module of the library, regardless of where the control module is located.

These instructions describe how to replace the picker with a new one. You may need to replace the picker if there are problems with the current one.

CAUTION:
Follow proper ESD protocol any time you are handling the robot assembly or any of its components (picker, Y-carriage asembly).

CAUTION:
Handle the picker assembly and flex cable gently. Do not crease or tear the flex cable.

Required tools:

- T10 Torx screwdriver, to loosen the picker assembly thumbscrews

1. Power off the library. When the library is powered off, the robot assembly slowly falls to rest in the bottom module of the library. You can service the picker assembly from this bottom module.
2. Open the bottom module's I/E station and access doors.
3. Reach inside the access door and rotate the picker so you can access the X-axis flex cable, which is located to the left of the picker. To obtain easy access to the X-axis flex cable, rotate the picker so its fingers point to the left rear corner of the control module.
4. Disconnect the X-axis flex cable. Using your hand, squeeze the tab of the flex cable, and then pull the cable out and up. The other end of the flex cable remains attached.

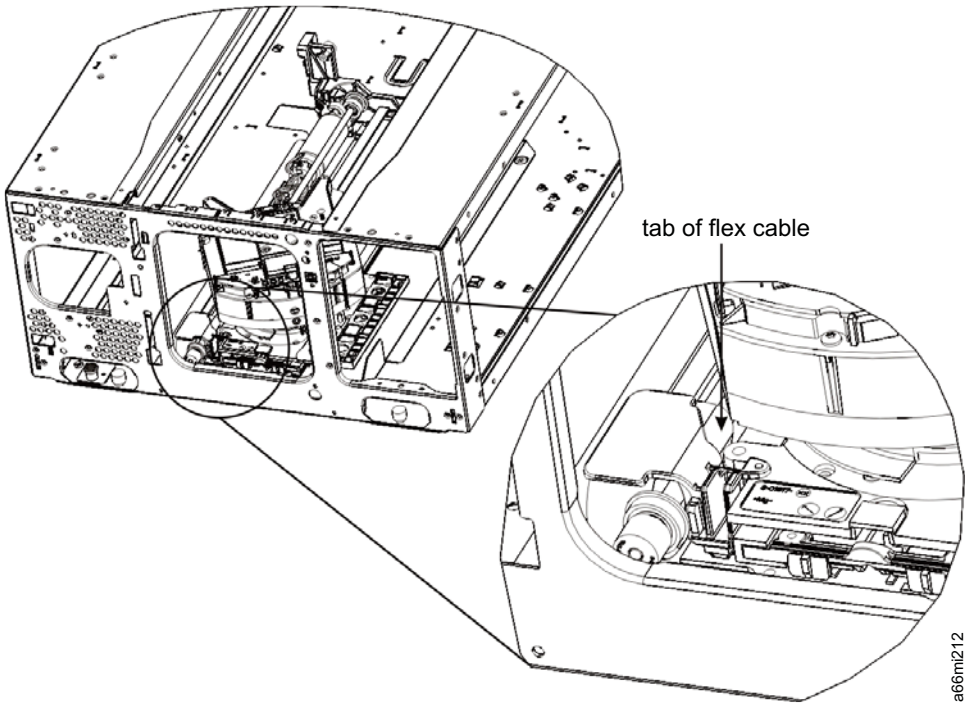

Figure 7-81. Disconnecting the flex cable

5. Using the T10 Torx screwdriver, loosen the thumbscrews located at the front and back of the picker assembly. You may need to slide the picker to access the thumbscrews.

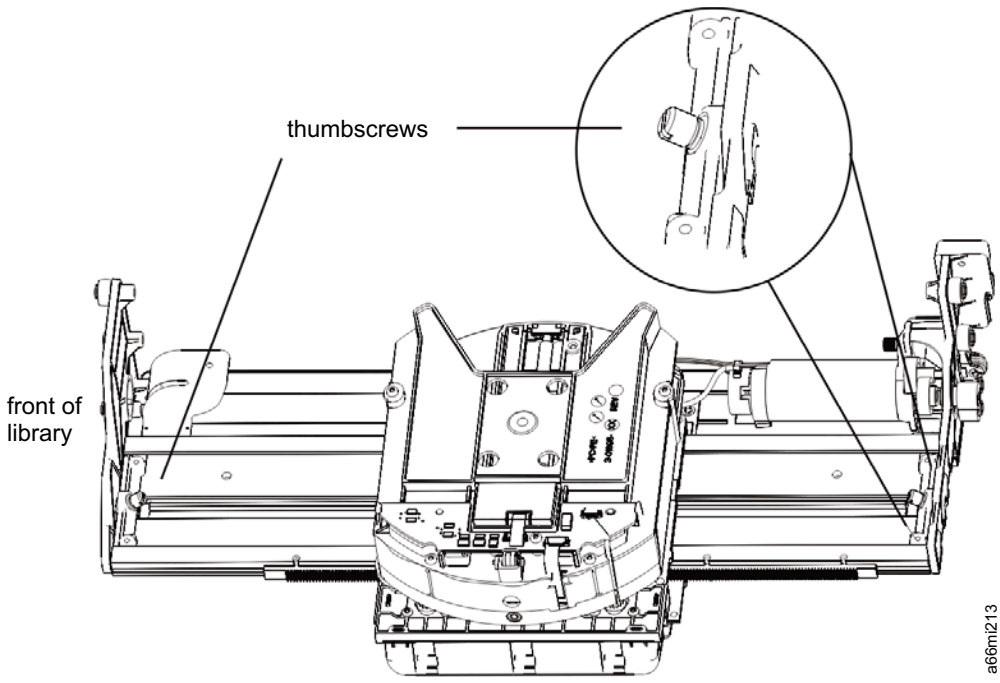

Figure 7-82. Loosening the thumbscrews

6. Lift the picker assembly up and out of the control module, through the access door. You will need to turn it on its side to remove it from the access door.
7. Replace the picker assembly with the new one. When inserting the new picker assembly, first align the rear indexing features, and then align the front indexing features and set the assembly into place. The picker assembly must be level.
8. Tighten the thumbscrews located at the front and back of the picker assembly.
9. Reconnect the X-axis flex cable. Remember that the black tab of the X-axis flex cable should be positioned above the bar of the picker assembly. Align the semi-circular part of the flex cable's tab with the post on the translator base of the picker assembly. Squeeze the tab, and push the cable connector down into its socket. Then push the tab toward the picker until it snaps into place.

   CAUTION:
   The X-axis flex cable connection is necessary to provide the power-off braking feature to the robot assembly. After you finish installing the picker and connecting the cable, test the installation. To do this, support the robot assembly under the broad metal X-axis base plate and lift the assembly. (Do NOT lift by the thin metal rod or the black plastic picker body.) You should feel resistance as you lift the robot assembly. Next, place one hand below the robot assembly and allow the assembly to fall to your hand. It should descend slowly. If you feel no resistance, or if the robot assembly falls quickly, re-check the X-axis cable connection. Failure to perform these steps may result in damage to the robot assembly.
10. Close the module's doors.
11. Power on the library.

Removing and Replacing the Model 1 Y-Carriage Assembly

The Y-carriage enables the picker to move up and down the length of the library, from one module to another. The Y-carriage assembly along with the picker assembly make up the entire robot assembly.

These instructions explain how to remove the Y-carriage assembly and replace it with a new one. To replace the Y-carriage assembly, remove the entire robot assembly (the Y-carriage assembly and the picker assembly) from the library.

Required tools:

- Phillips #2 screwdriver, for removing and replacing the top cover plate
- T10 TORX screwdriver, for loosening and tightening the thumbscrew that attaches the cable spool clip to the robot assembly

1. Remove the robot assembly from the library, following the complete instructions in "Removing the Model 1 Robot Assembly from the Library" on page 7-66
2. Separate the robot into the Y-carriage assembly and picker assembly. For details, see "Removing and Replacing the Model 1 Picker Assembly from the Y-Carriage Assembly Inside the Library" on page 7-74 (The instructions for removal are the same whether inside or outside the library.)

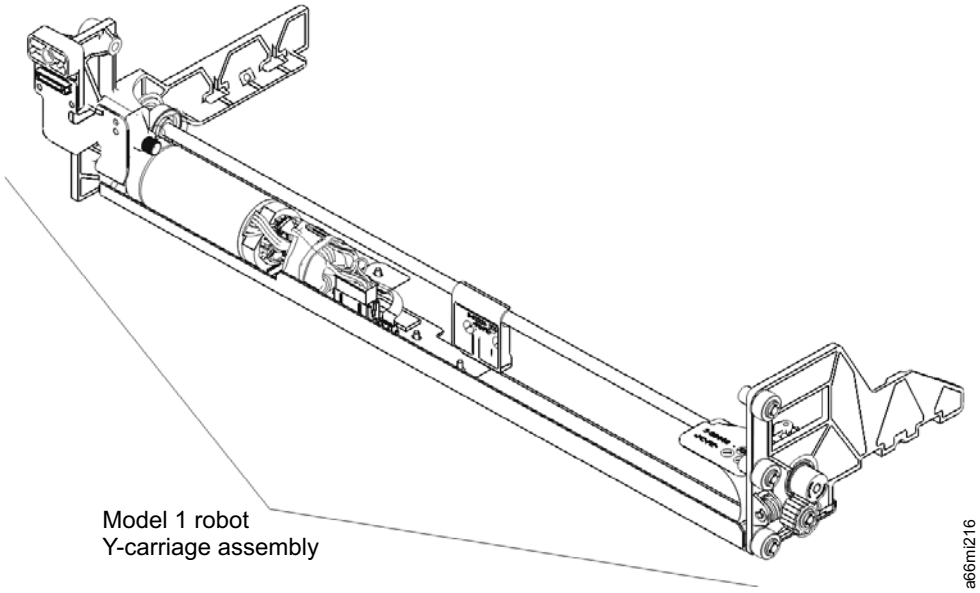

Figure 7-83. Model 1 Robot: Y-carriage Assembly

3. Reassemble the new Y-carriage assembly and the picker assembly outside of the module.
4. Replace the robot in the library, following the complete instructions in "Installing the Model 1 Robot Assembly in the Library" on page 7-70

M2 Robot Assembly

The M2 Robot Assembly houses the Y Motor, Robot Controller Board, and the Picker.

Removing the M2 Robot Assembly from the Library

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Remove the Control Module from the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
3. Remove the top cover of the control module, if necessary.

4. Open the I/O Station door then the Access Door to access the M2 Robot Assembly.
5. Optionally, remove the I/O Station from the control module for easier access.
6. Manually lift the M2 Robot Assembly, raise it along the track, and carefully lift it out. Be careful not to damage the Cable Spool flat cable (**2** in Figure 7-84). Set the M2 Robot Assembly on top of the library and loosen the thumbscrew (**1** in Figure 7-84) to disconnect the cable spool.

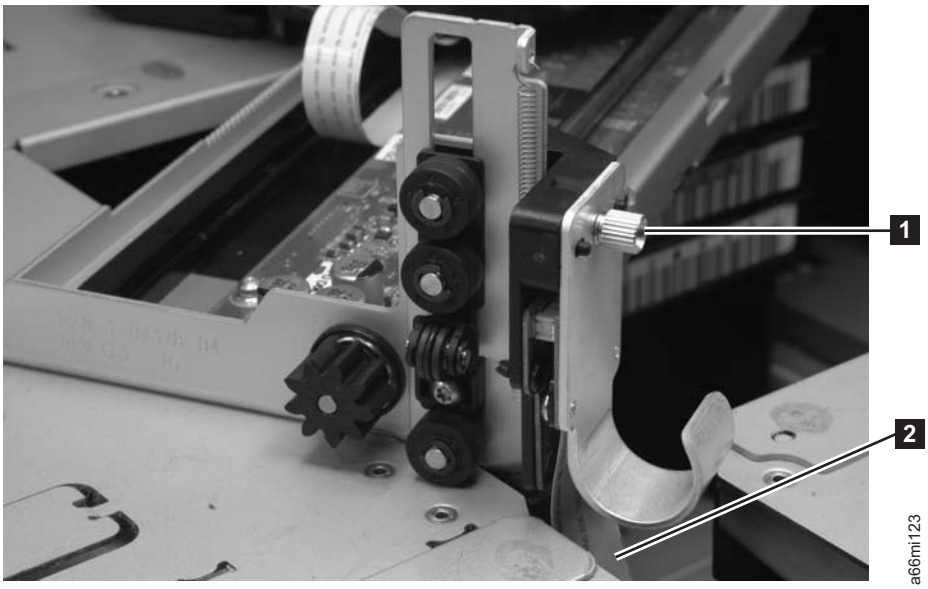

Figure 7-84. Thumb screw securing Cable Spool

7. Remove any media that is in the picker.
8. Carefully lower the Cable Spool connector (**3** in Figure 7-85 on page 7-79) and hook it around the black plastic guide peg (**2** in Figure 7-85 on page 7-79).

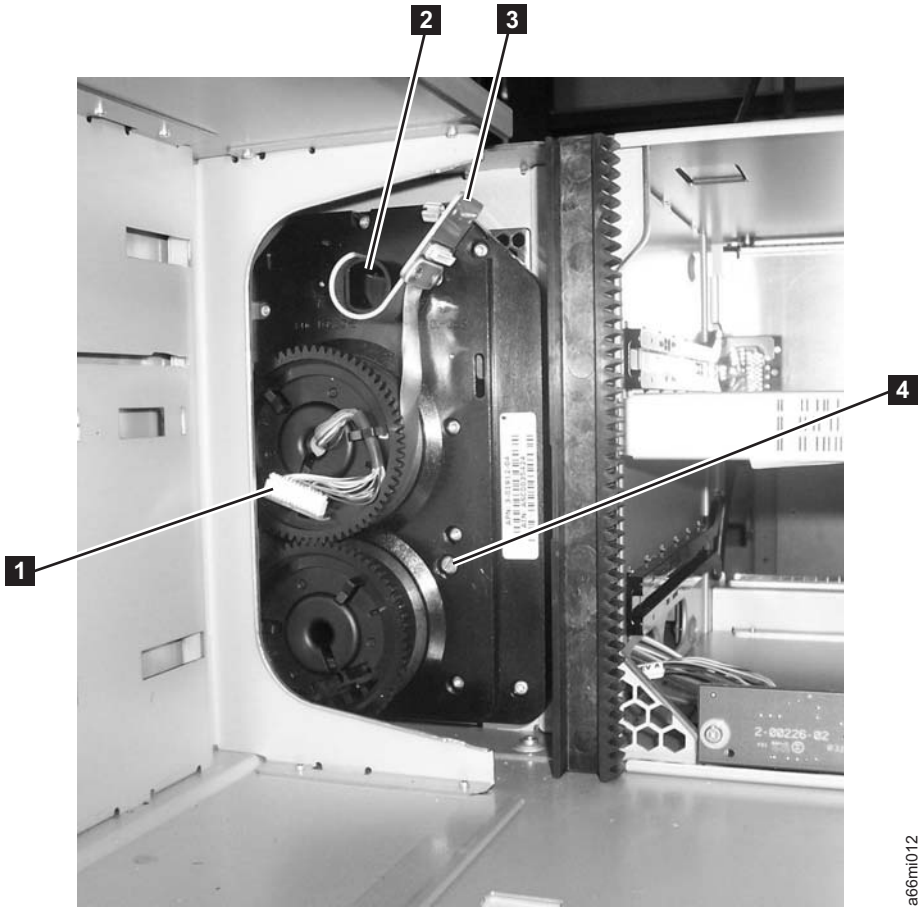

Figure 7-85. Cable Spool (with storage columns removed)

Replacing the M2 Robot Assembly

1. Ensure all gear racks are properly positioned and that they contain **NO GAPS** between units in the library.
2. Set the M2 Robot Assembly on top of the control module as shown in Figure 7-84 on page 7-78.
3. Remove the Cable Spool connector (**3** in Figure 7-85) from the black plastic peg (**2** in Figure 7-85).
4. Carefully lift the Cable Spool connector.

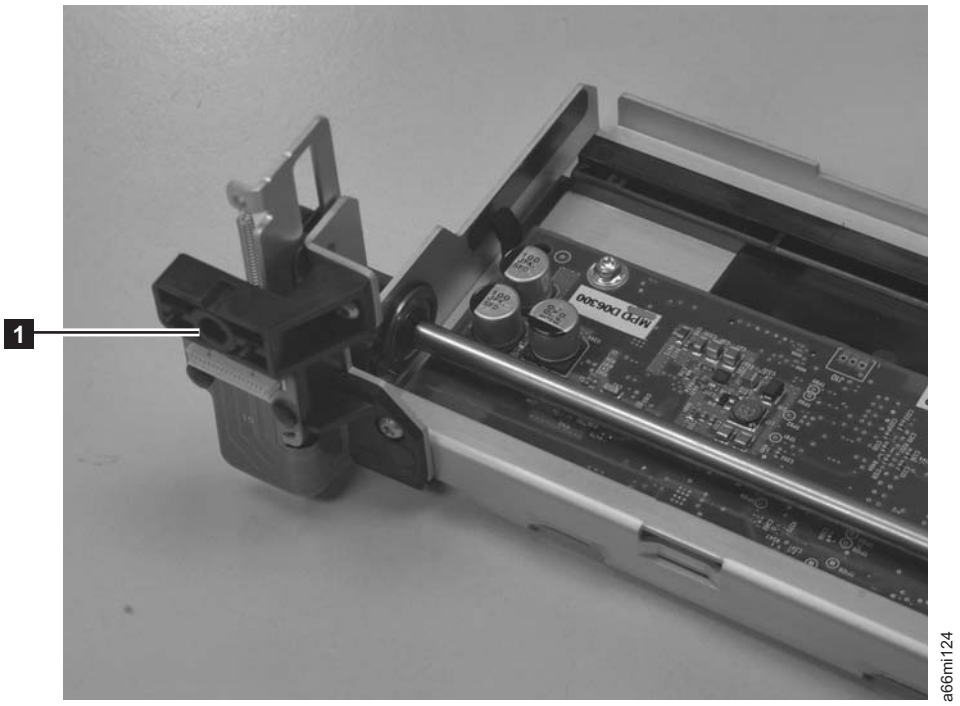

Figure 7-86. Thumbscrew securing Cable Spool

5. Tighten the thumb screw to connect the spooler cable to the M2 Robot Assembly (**1** in Figure 7-86).
6. Lower the M2 Robot Assembly by tilting its gears at a 45° angle onto the top of the front and rear gear racks (see Figure 7-87 on page 7-81 and Figure 7-88 on page 7-81).

   Important: BE VERY CAREFUL TO START BOTH M2 ROBOT ASSEMBLY GEARS TOGETHER TO ENSURE THE M2 ROBOT ASSEMBLY IS LEVEL.

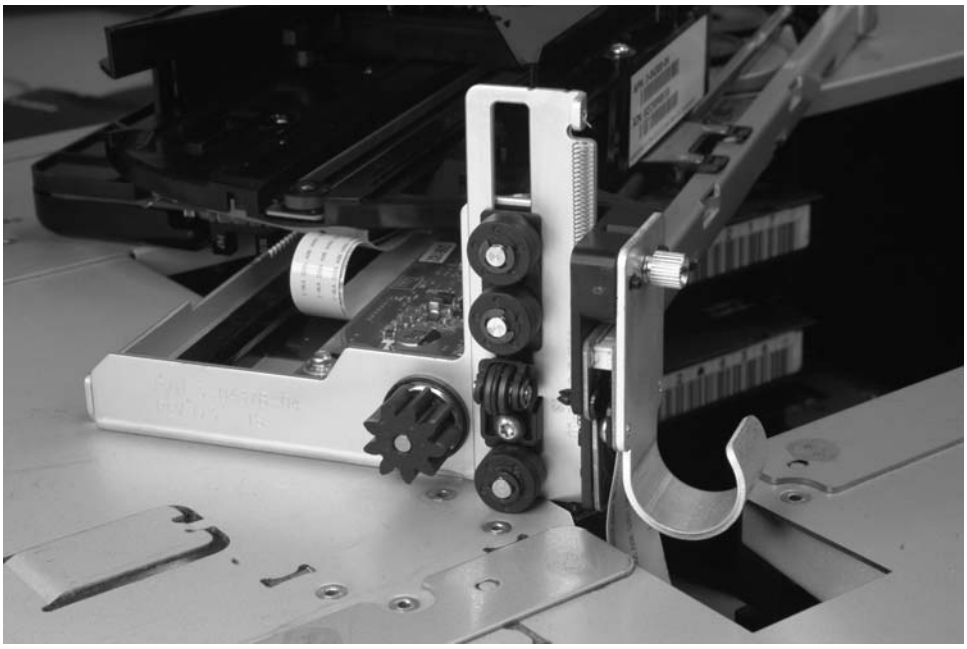

Figure 7-87. Guide rollers on M2 Robot Assembly

Figure 7-88. M2 Robot Assembly rollers inserted in gear rack track

7. After lowering the M2 Robot Assembly a few teeth, verify that the M2 Robot Assembly is level with the library chassis. If it is not level, remove the M2 Robot Assembly and reinsert.
8. Replace the I/O Station.
9. Close the Access Door then the I/O Station door.
10. Replace the top cover of the control module, if necessary.

11. If necessary, replace the Control Module into the library. See the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel* for more information.
12. Perform “Returning a Library or Library Module to Normal Operations after Repairs” on page 7-3.

M2 Picker Assembly

The Picker moves media to and from storage slots and tape drives and positions the Bar Code Scanner to enable it to read bar code labels on cartridges and fiducials on cartridge magazines and tape drives. The Picker Assembly is attached to the Y-Axis/Picker Assembly. If the Picker Assembly requires service, you can either remove it from the Y-Axis/Picker Assembly while the Y-Axis/Picker Assembly is still in the library, or you can remove the Y-Axis/Picker Assembly from the library and then disconnect the Picker Assembly from it.

Removing the Picker Assembly from the M2 Robot Assembly Outside of a Library

1. Remove the M2 Robot Assembly from the library. (See "Installation Instructions for Removing/Replacing an M2 Robot Assembly: IBM System Storage TS3310 Tape Library", or "Removing the M2 Robot Assembly from the Library" in the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel*).
2. Slide Picker Assembly to the forward side of the Y-carriage as shown in Figure 7-89.

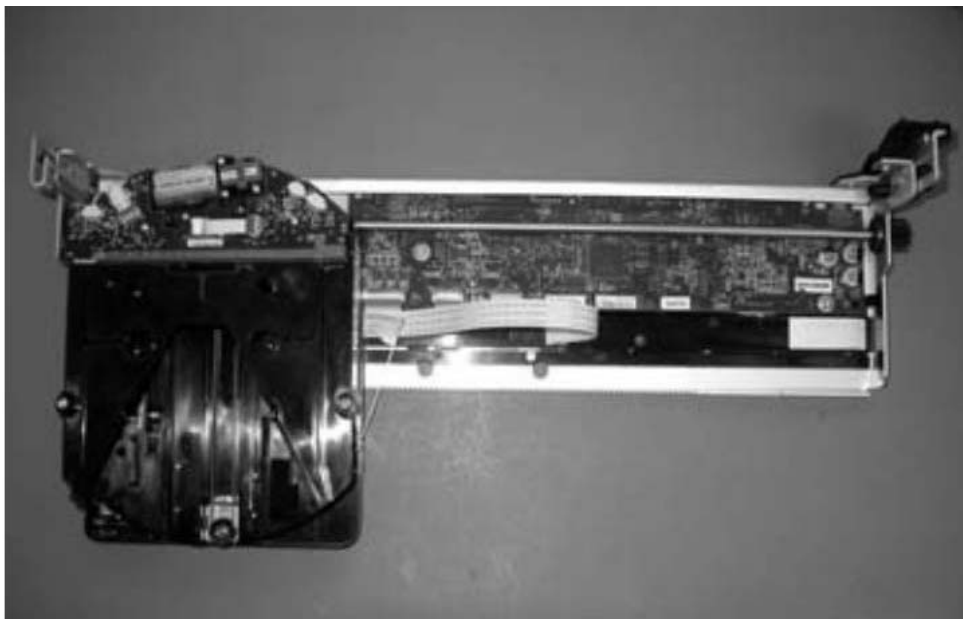

Figure 7-89. Picker Assembly on Forward side of Y-carriage

3. Hold robot as shown in Figure 7-90 on page 7-83 and locate the release lever (**1** in Figure 7-91 on page 7-83) on the underside of the Picker Assembly. Rotate the release lever forward and lift up on the Picker Assembly. It will pivot against the sheet metal edge near the drive shaft. Pull to the right and remove the Picker Assembly.

CAUTION:
The flex cables are still attached to the M2 Robot Assembly.

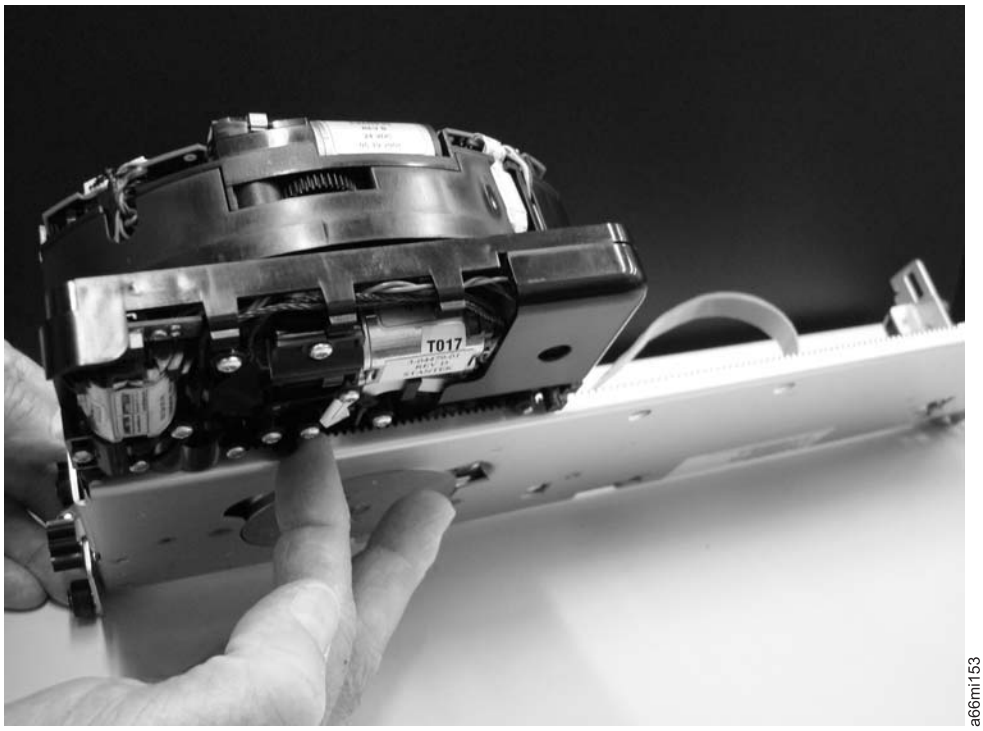

Figure 7-90. Press the release lever

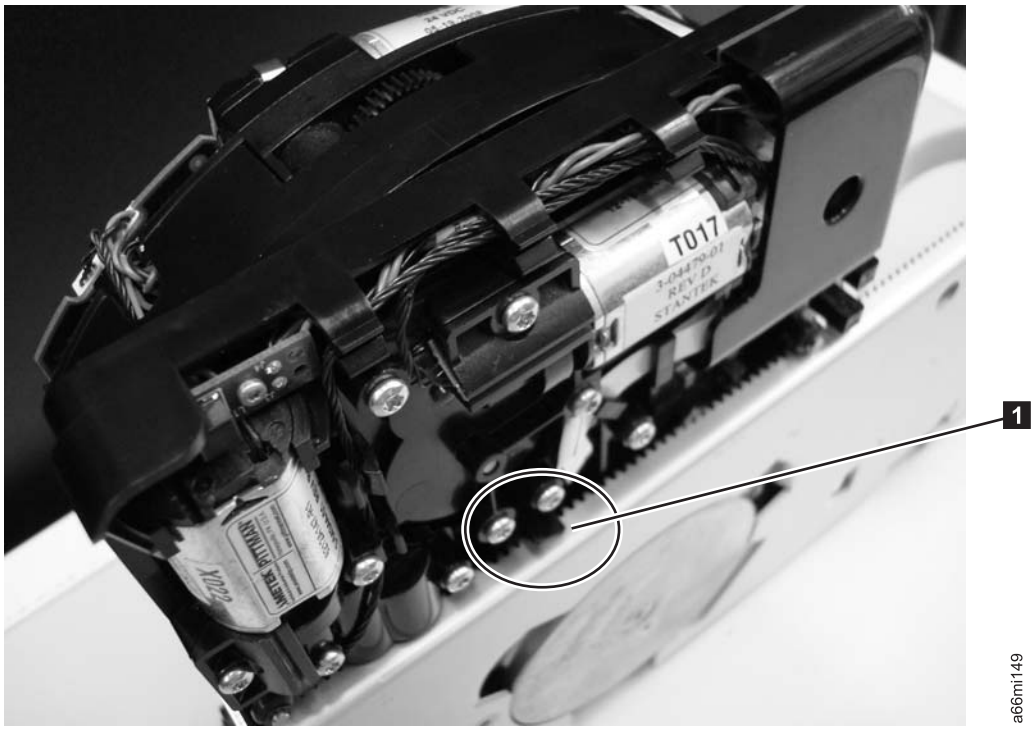

Figure 7-91. Close-up of the release lever

4. Once detached from the M2 Robot Assembly, position the Picker Assembly next to the M2 Robot Assembly so that the flex cable is not stressed, being careful not to kink or crease the cable.
5. Disconnect the flex cables from the M2 Robot Controller Board.
   a. Lift the cable protector (Figure 7-92).

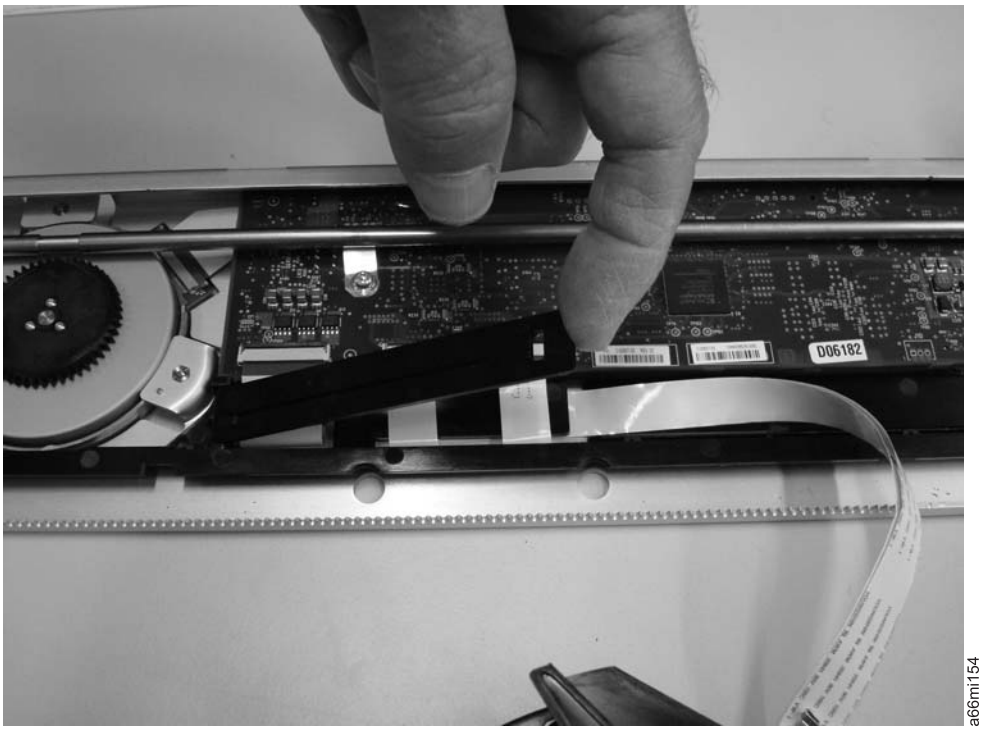

Figure 7-92. Lift the cable protector

   b. Lift up the small lever/clamp on the back of the connector to release the flex cable. (Figure 7-93 on page 7-85)

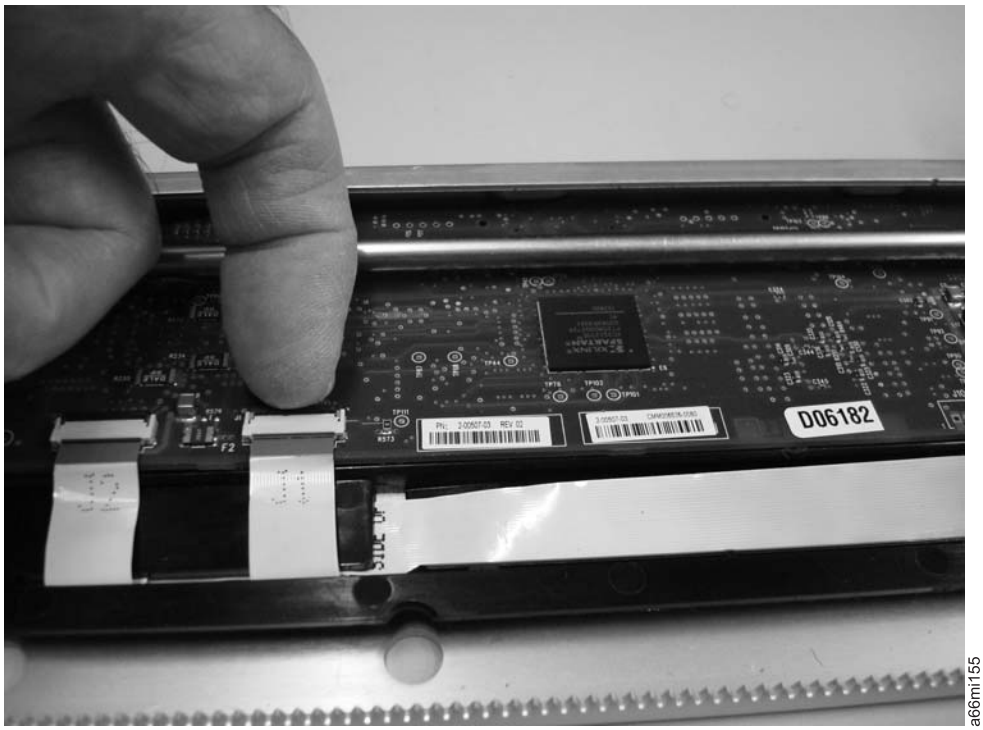

Figure 7-93. Lift the lever clamp on the back of the connectors

CAUTION:
This lever/clamp is very fragile. Lift it with a fingernail or similar small object

c. Repeat the above steps for the second cable/connector.
d. Slide the flex cables to the rear as in Figure 7-94 on page 7-86.

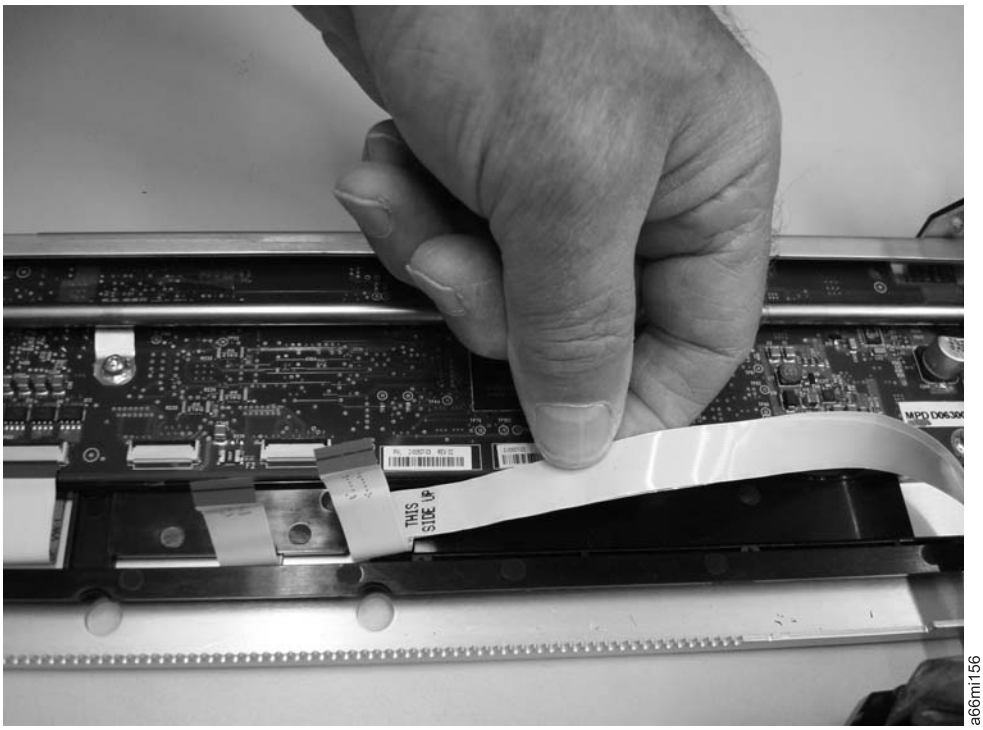

Figure 7-94. Slide cable to the rear

Replacing the Picker Assembly onto the M2 Robot Assembly Outside of a Library

1. Place the Picker Assembly adjacent to the M2 Robot Assembly on a bench.
2. Connect the flex cables to the Robot Controller Board.
   a. Slide the cables under the plastic guide (see Figure 7-95 on page 7-87).

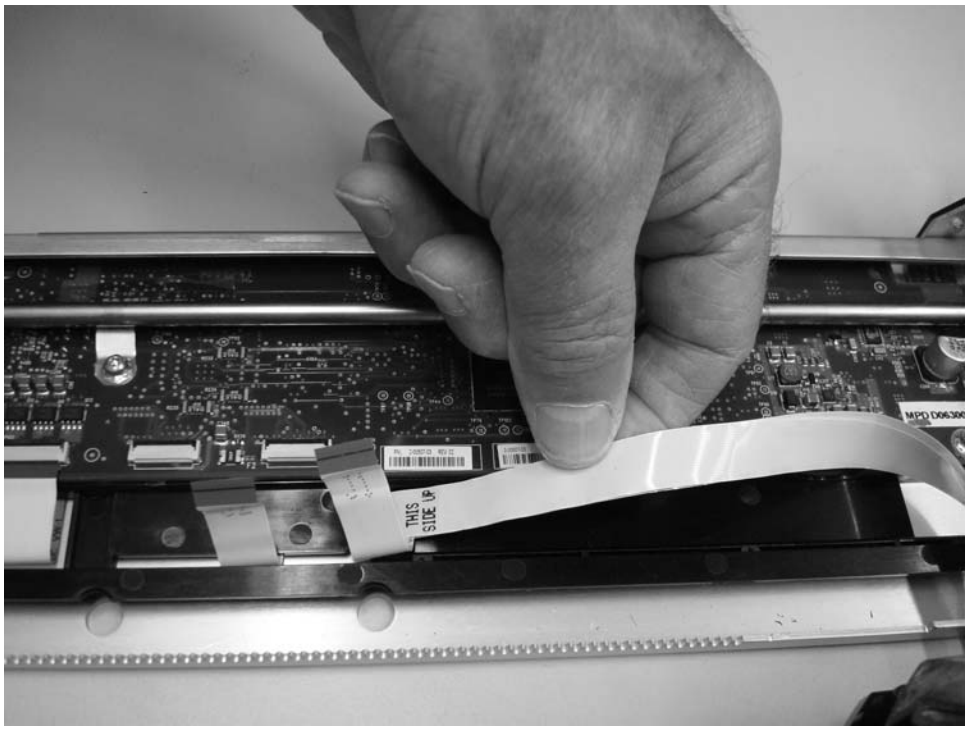

Figure 7-95. Slide the cables under the plastic guide

b. Connect the cables. Note the guideline on the blue backer of the flex cable (See Figure 7-96 on page 7-88. When fully inserted, the guideline on the flex cable will be flush with the edge of the connector. Press down on the back latch on the connector to lock the cable into place. See Figure 7-97 on page 7-88.

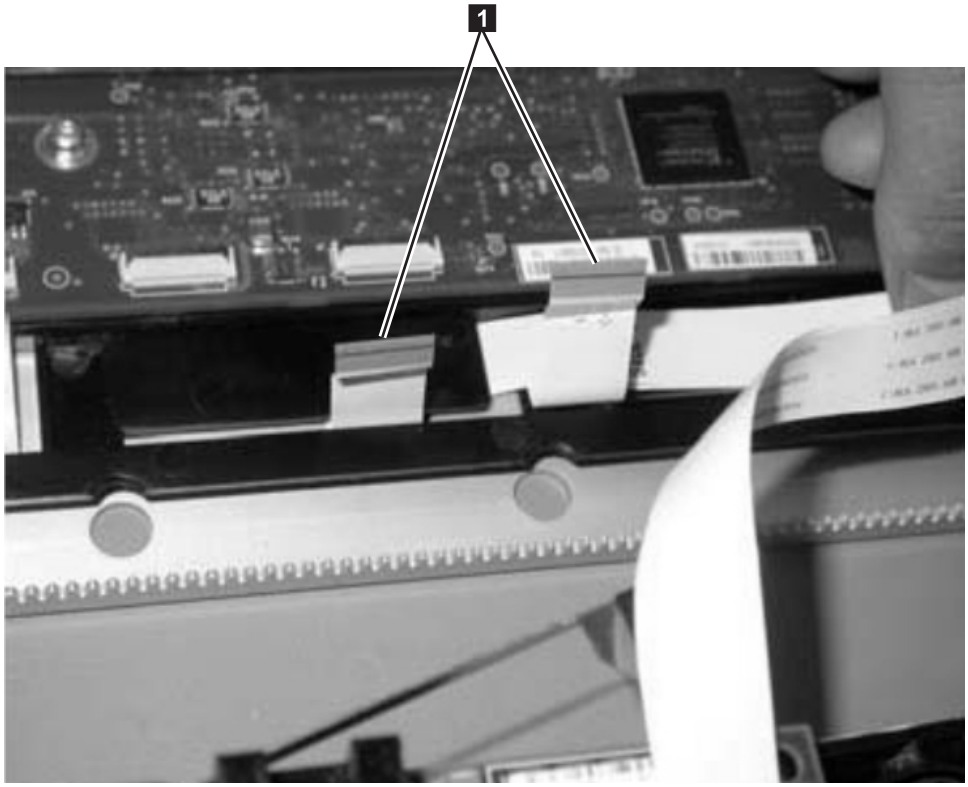

Figure 7-96. Guideline

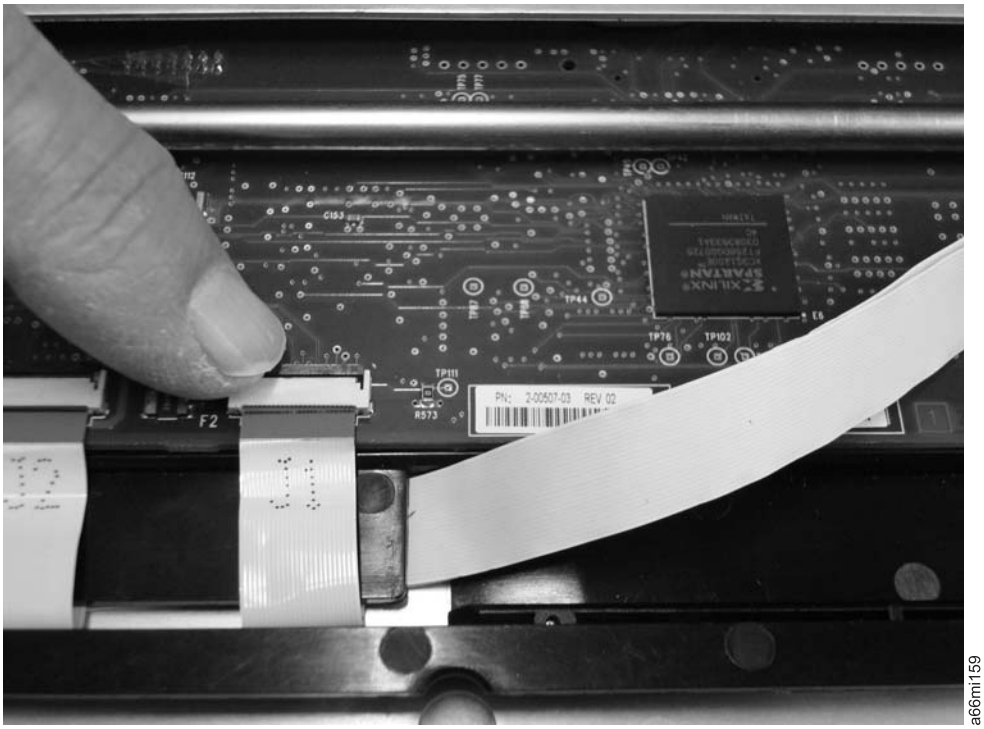

Figure 7-97. Connect and lock the flex cable

3. Close the Cable protector.

4. Connect the Picker Assembly to the M2 Robot Assembly.
   a. Position the Picker Assembly at the front of the M2 Robot Assembly.
   b. Locate the slot feature on the Picker Assembly and slide it over the sheet metal edge on the M2 Robot Assembly.
      1) The slot is indicated by **1** in Figure 7-98

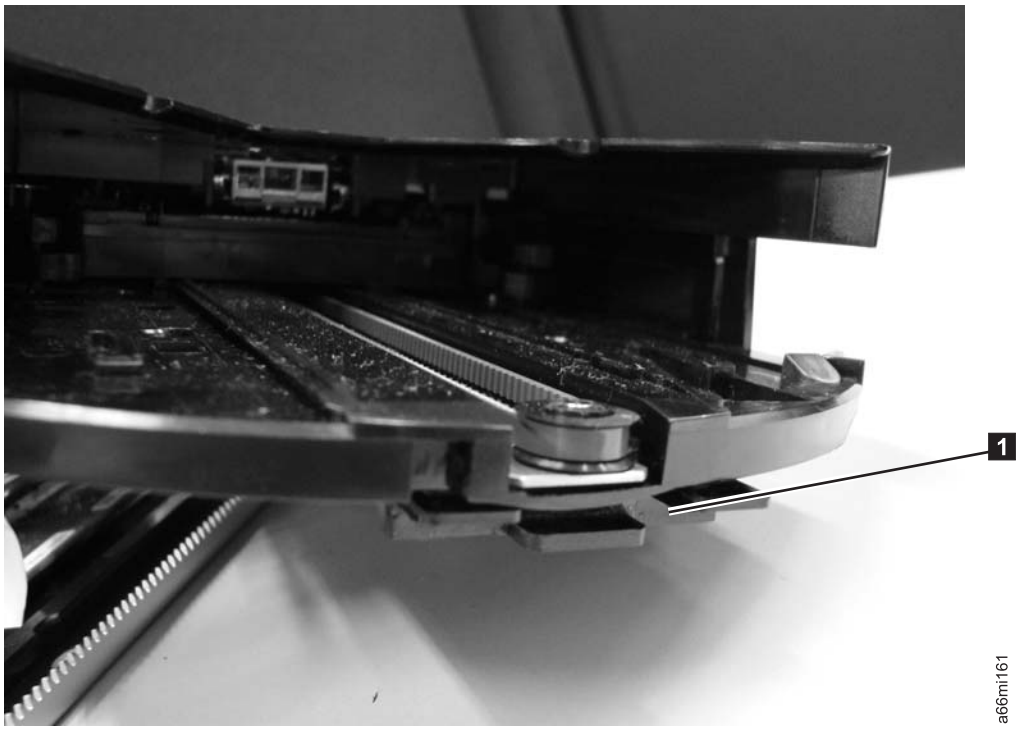

Figure 7-98. Slot on the Picker Assembly

      2) Align the slot on the Picker to the sheet metal edge on the M2 Robot Assembly (see Figure 7-99 on page 7-90.

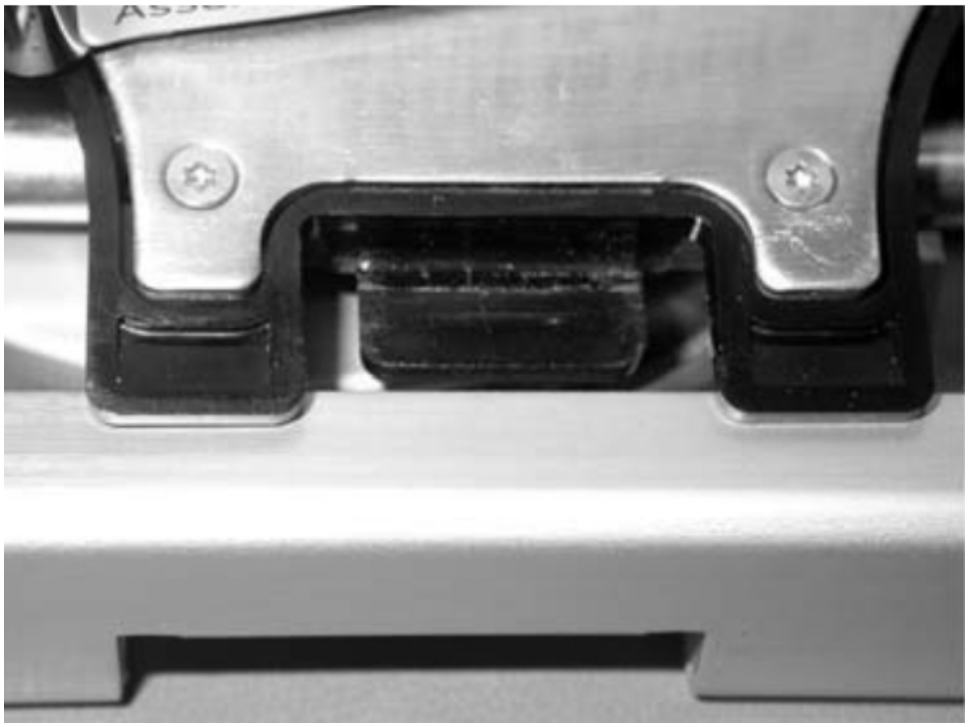

Figure 7-99. Align slot to sheet metal edge

3) Slide the Picker over the sheet metal edge on the M2 Robot Assembly (see Figure 7-100).

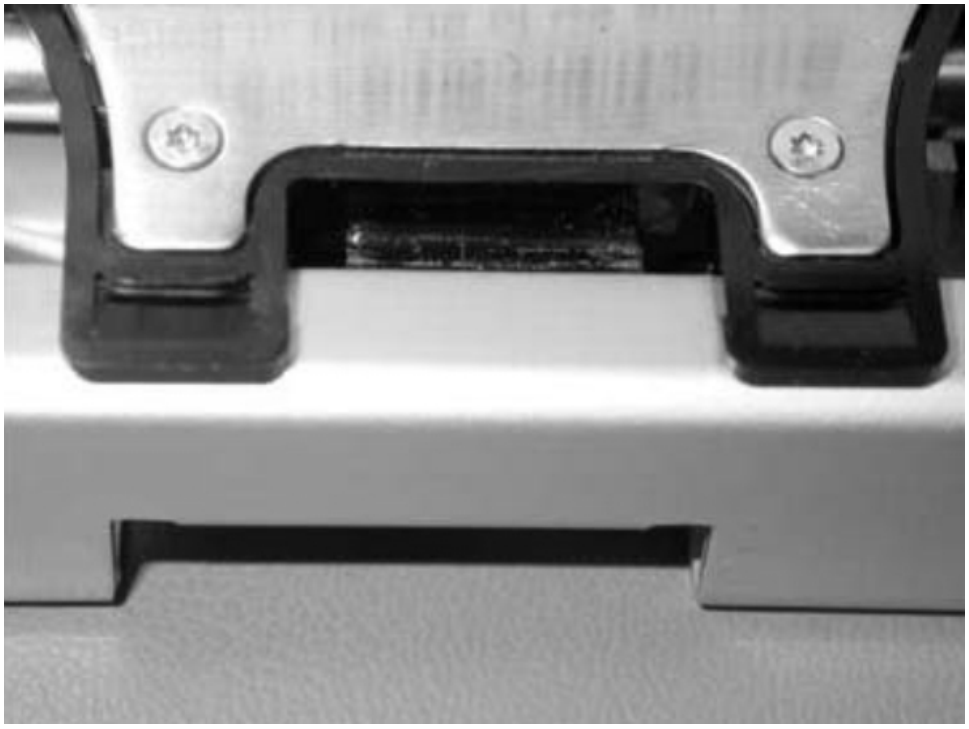

Figure 7-100. Slide over sheet metal edge

5. Lower and latch the Picker Assembly to the M2 Robot Assembly.

a. Locate the release lever on the under side of the Picker Assembly. While holding the release lever in the forward position, lower the Picker Assembly onto the M2 Robot Assembly. Ensure the Picker is all the way to the front of the Robot Assembly.

b. There are two rollers on the Picker Assembly that align with the two slots in the M2 Robot Assembly (see Figure 7-101). Once the rollers are resting on the M2 Robot Assembly, release the lever.

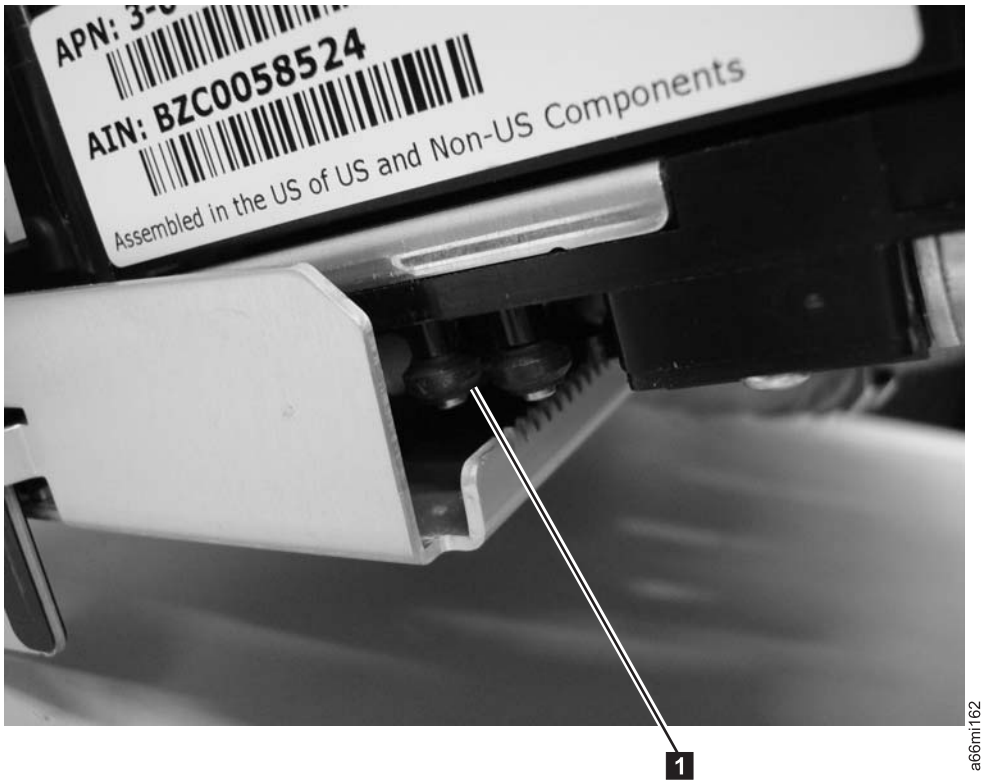

Figure 7-101. Picker Assembly rollers

c. Verify that the Picker Assembly is fully resting on the M2 Robot Assembly by slowly moving the Picker Assembly toward the rear. If it moves smoothly, installation is complete.

6. Replace the M2 Robot Assembly. (See "Installation Instructions for Removing/Replacing an M2 Robot Assembly: IBM System Storage TS3310 Tape Library", or "Replacing the M2 Robot Assembly" in the *IBM System Storage TS3310 Tape Library Maintenance Information for IBM Service Personnel*).

Removing the Picker Assembly from the M2 Robot Assembly Inside of a Library

The Picker Assembly is designed so that it can be removed from the M2 Robot Assembly by a service technician while installed in a library. The M2 Robot Assembly remains in the library, and the Picker Assembly is removed through the front door. In the photos below, the top of the library is removed for clarity.

1. If the M2 Robot Assembly is at the bottom of the library, open the front door and manually raise it into the Control Module.
2. Engage the picker locking mechanism. (See **1** inFigure 7-102 on page 7-92).

Figure 7-102. Picker locking mechanism

3. If necessary, remove the I/O Station(s) from the library.
4. Rotate the M2 Picker Assembly so that it is facing the right side of the library, and slide it all the way forward toward the front as shown in Figure 7-103 on page 7-93.

Figure 7-103. Rotate M2 Picker Assembly

5. Lift the M2 Robot Assembly as shown in Figure 7-104 to gain access to the underside of the Picker Assembly.

Figure 7-104. Lift M2 Picker Assembly

6. Remove any media that is in the picker.

7. Locate the release lever (**1** in Figure 7-105) on the under side of the Picker Assembly and pull it forward. While holding the release lever forward, lift up on the right side of the Picker Assembly and lift it off of the M2 Robot Assembly (see Figure 7-106 on page 7-95).

   Note: The flex cables are still attached to the Robot Controller Board.

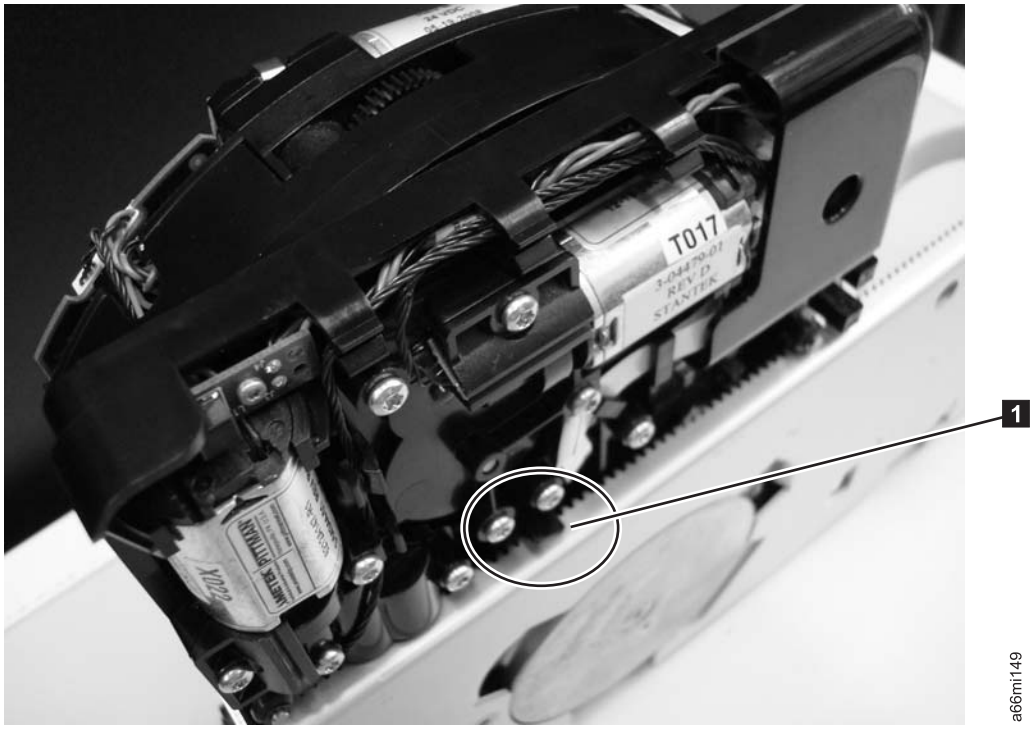

Figure 7-105. Close-up of the release lever

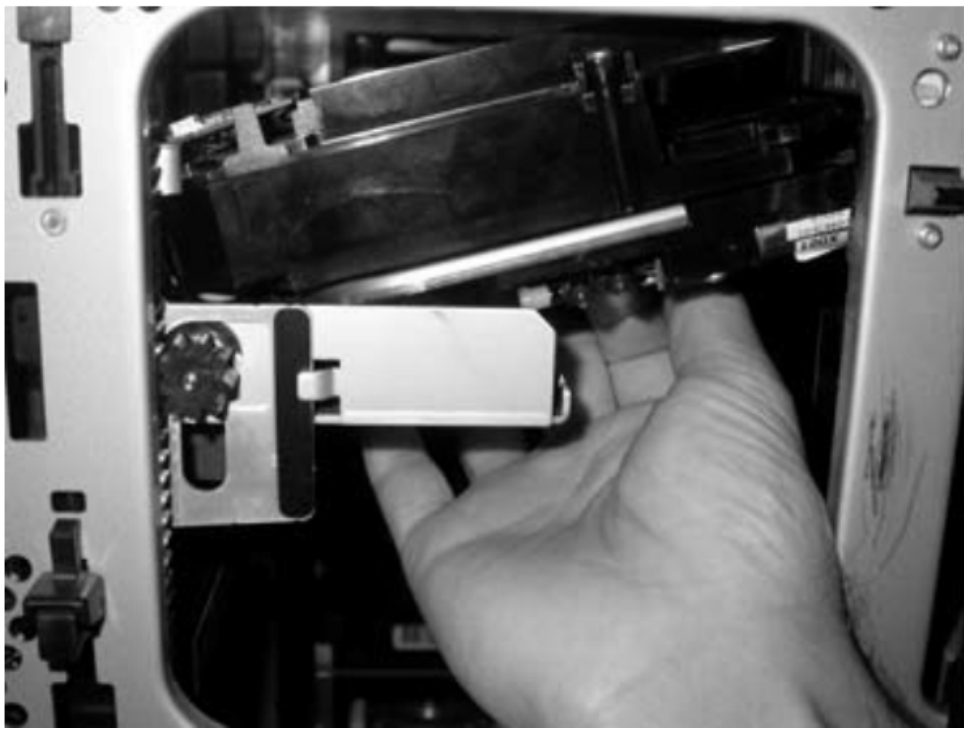

Figure 7-106. Lift Picker

8. Carefully set the Picker Assembly toward the rear of the M2 Robot Assembly so you can access the robot controller board connectors.
9. Disconnect the two rear flex cables from the Robot Controller Board.
   a. Lift the cable protector from the back side and pull forward (Figure 7-107 on page 7-96).

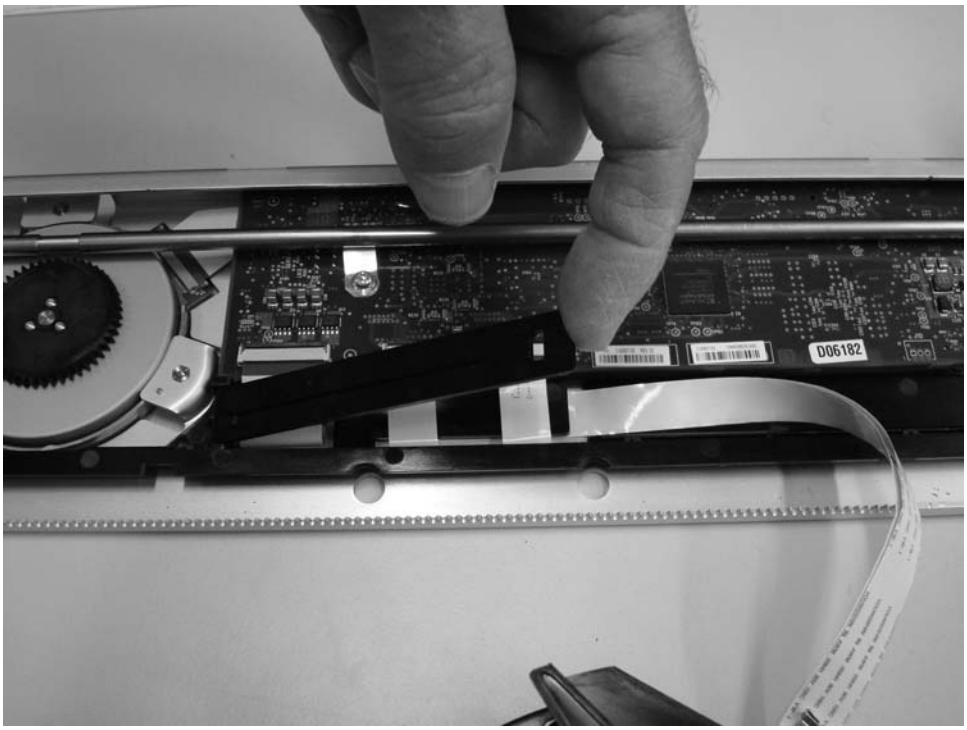

Figure 7-107. Lift the cable protector

b. Lift up the small lever/clamp on the back of the connector to release the flex cable. (See Figure 7-108).

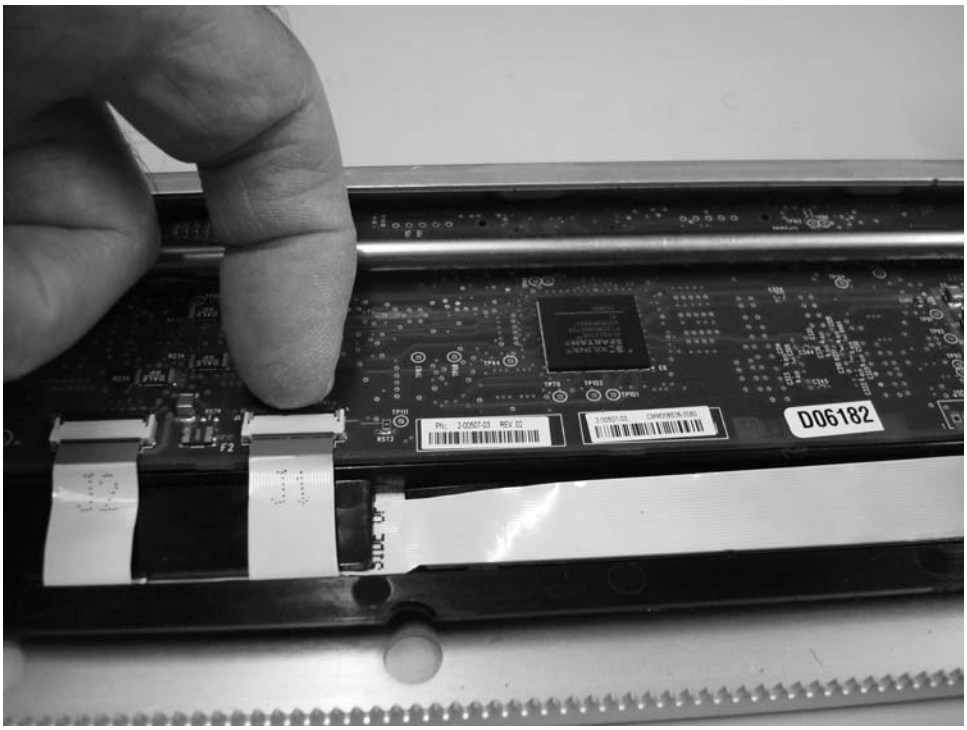

Figure 7-108. Lift the lever/clamp on the back of the connectors

CAUTION:
This lever/clamp is very fragile. Lift it with a fingernail or similar small object

c. Repeat the above steps for the second cable/connector.

d. Slide the flex cables to the rear as in Figure 7-109.

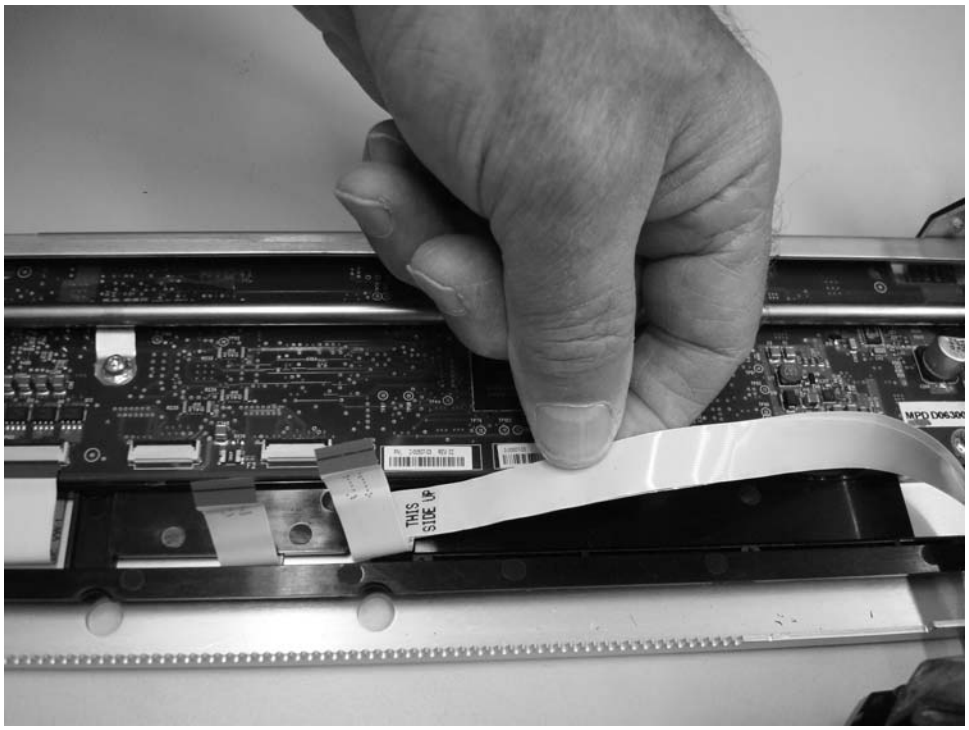

Figure 7-109. Slide cable forward

e. Close the cable protector as in Figure 7-110 on page 7-98.

Figure 7-110. Close the cable protector

10. Carefully lift and tilt the Picker Assembly and pull it out the front door as shown in Figure 7-111.

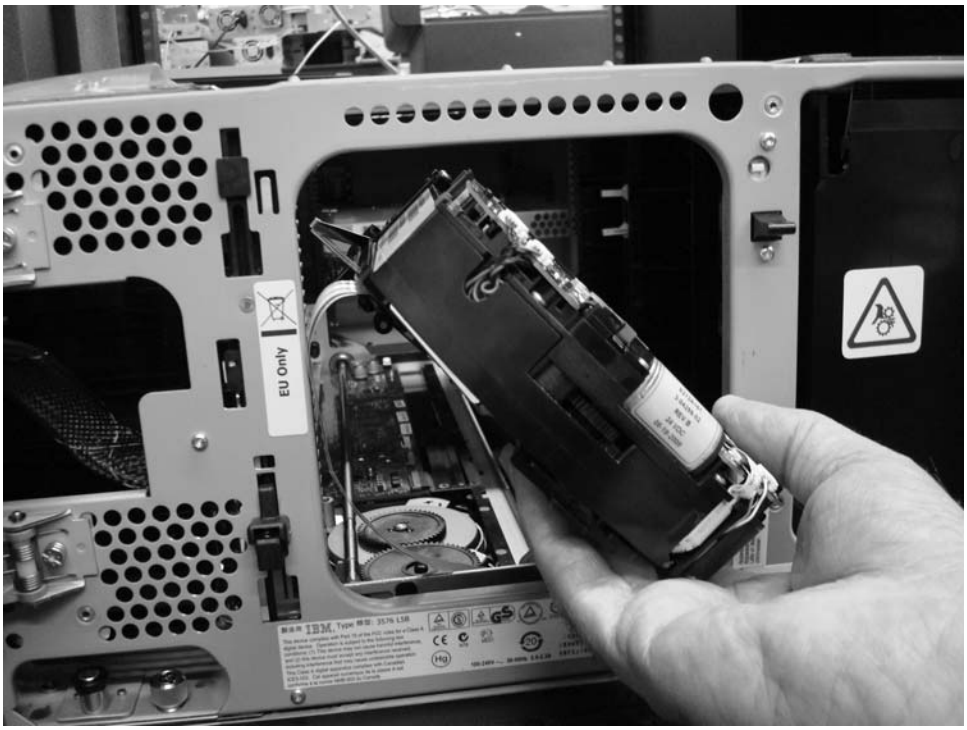

Figure 7-111. Remove the Picker Assembly

Replacing the Picker Assembly onto the M2 Robot Assembly Inside of a Library

1. Carefully insert the Picker assembly through the front door as shown in Figure 7-112. You may need to tilt the Picker Assembly slightly to allow it to fit. Set the Picker on the top of the M2 Robot assembly toward the rear of the library. Be careful not to bend or crease the flex cable.

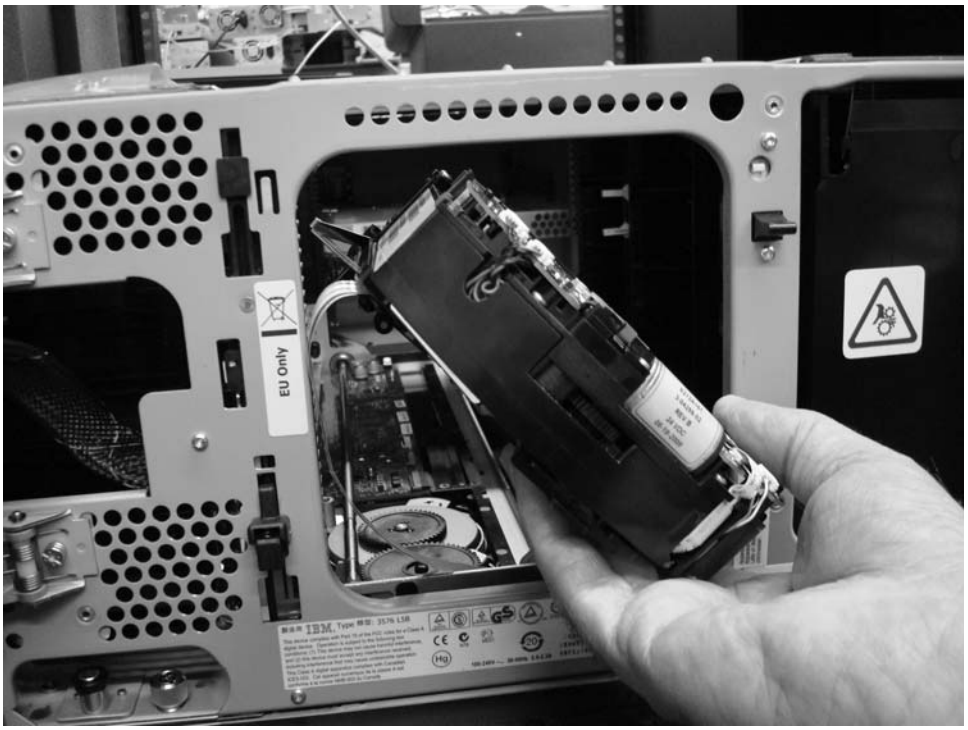

Figure 7-112. Insert Picker through the front door

2. Connect the flex cables to the M2 Robot Assembly Controller Board.
   a. Lift the cable protector. (See Figure 7-113 on page 7-100)

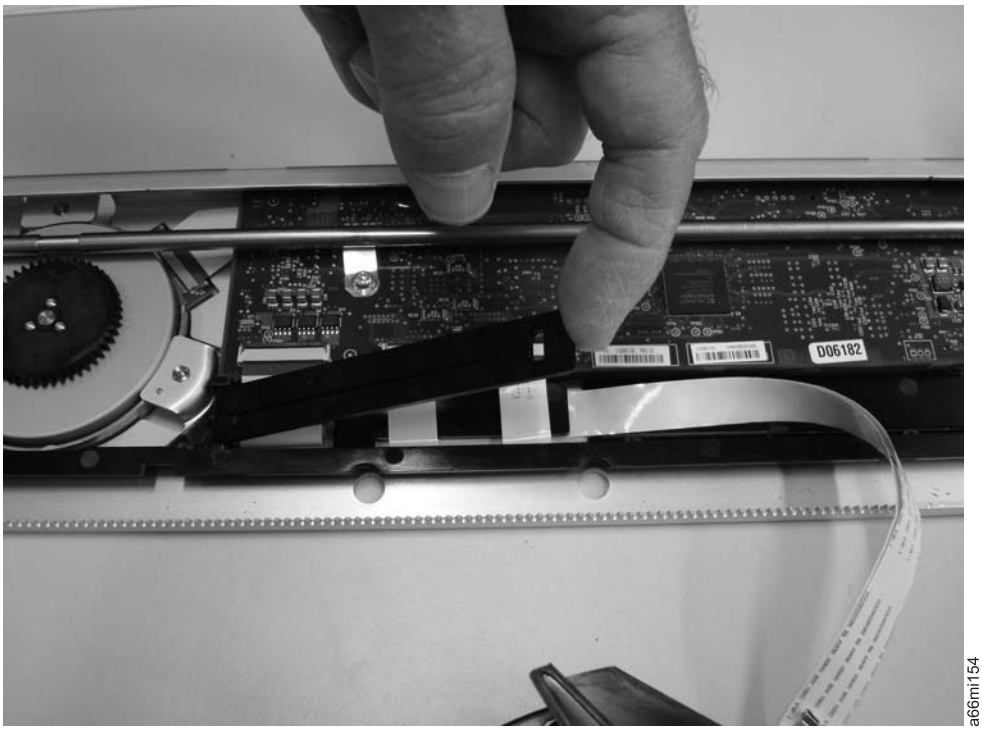

Figure 7-113. Lift the cable protector

b. Slide the two flat cables to the front, under the plastic guide. (See Figure 7-114)

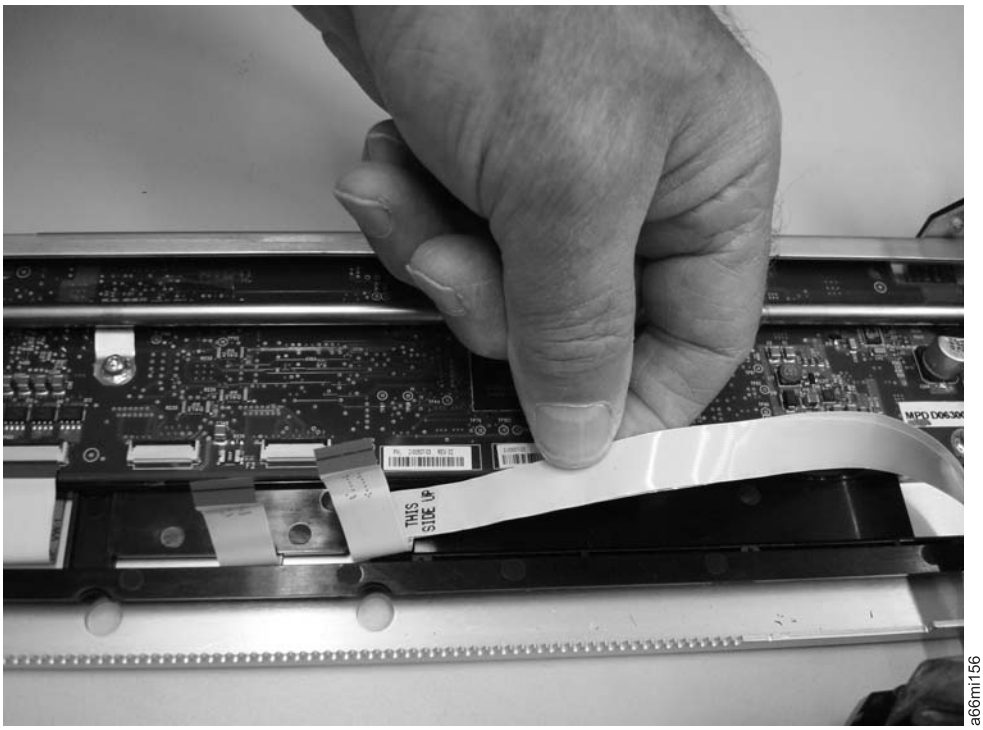

Figure 7-114. Slide the flat cables to the front

c. Connect the cables. Note that there is a black line on the blue portion of each flex cable. (See Figure 7-115). When fully inserted, the black line on the flex cable will be flush with the edge of the connector. Press down on the back latch on the connector to lock the cable into place. (See Figure 7-116 on page 7-102.)

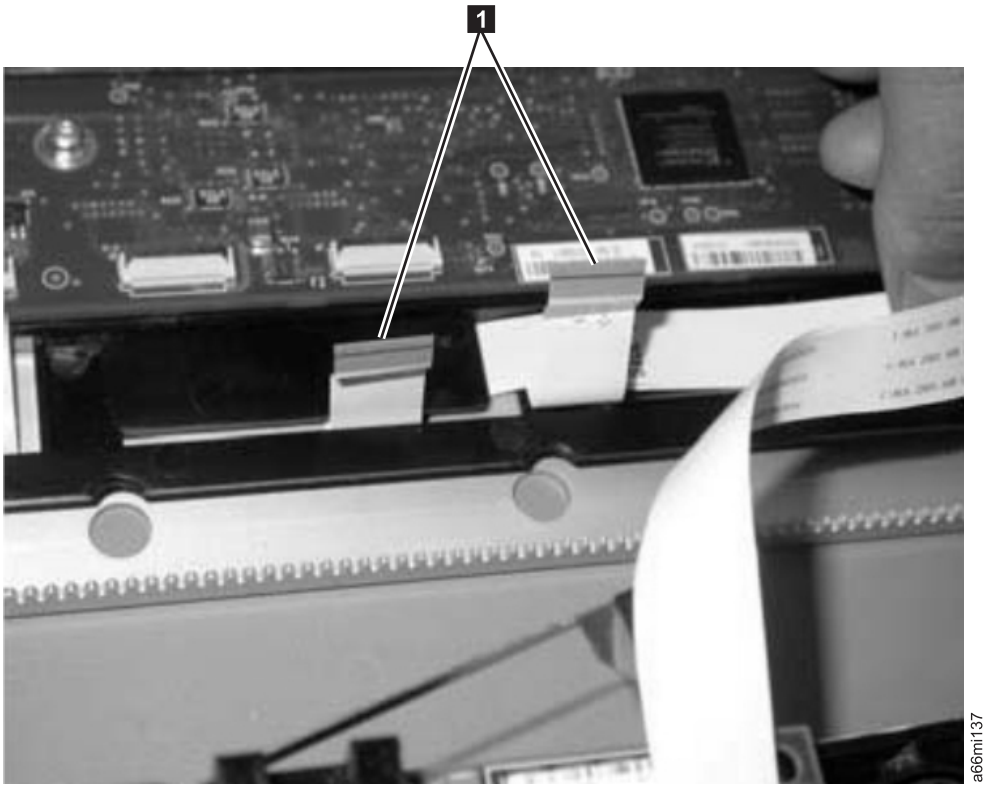

Figure 7-115. Black guideline on the cable

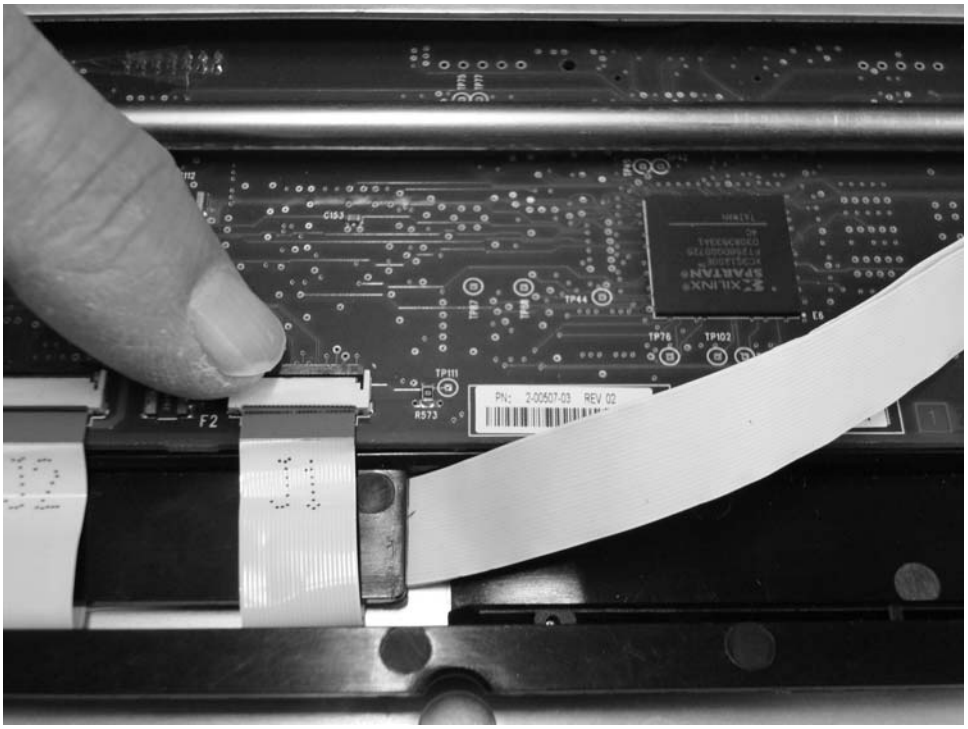

Figure 7-116. Locking the cable into place

d. Close the cable protector. (See Figure 7-117.)

Figure 7-117. Closing the cable protector

3. Connect the Picker to the M2 Robot Assembly.
   a. Position the Picker Assembly at the front of the M2 Robot Assembly.

b. Locate the slot feature on the Picker Assembly and side it over the sheet metal edge on the M2 Robot Assembly. (See Figure 7-118).

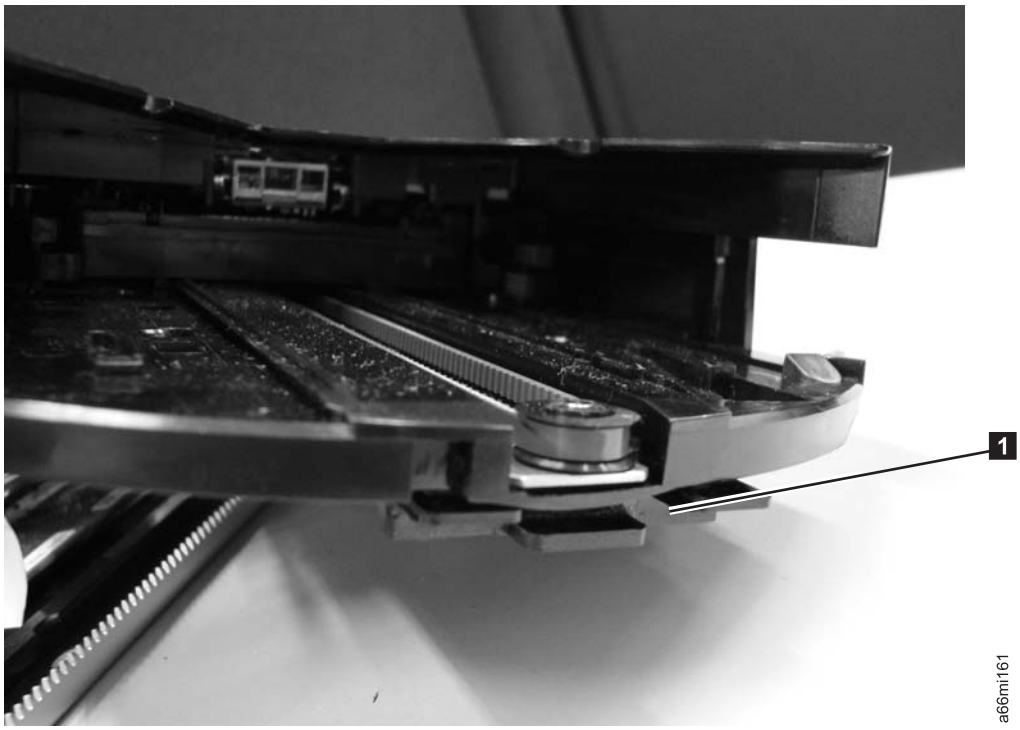

Figure 7-118. Slot feature on the Picker Assembly

1) Align the slot on the picker to the sheet metal edge on the M2 Robot Assembly, as shown in Figure 7-119 on page 7-104

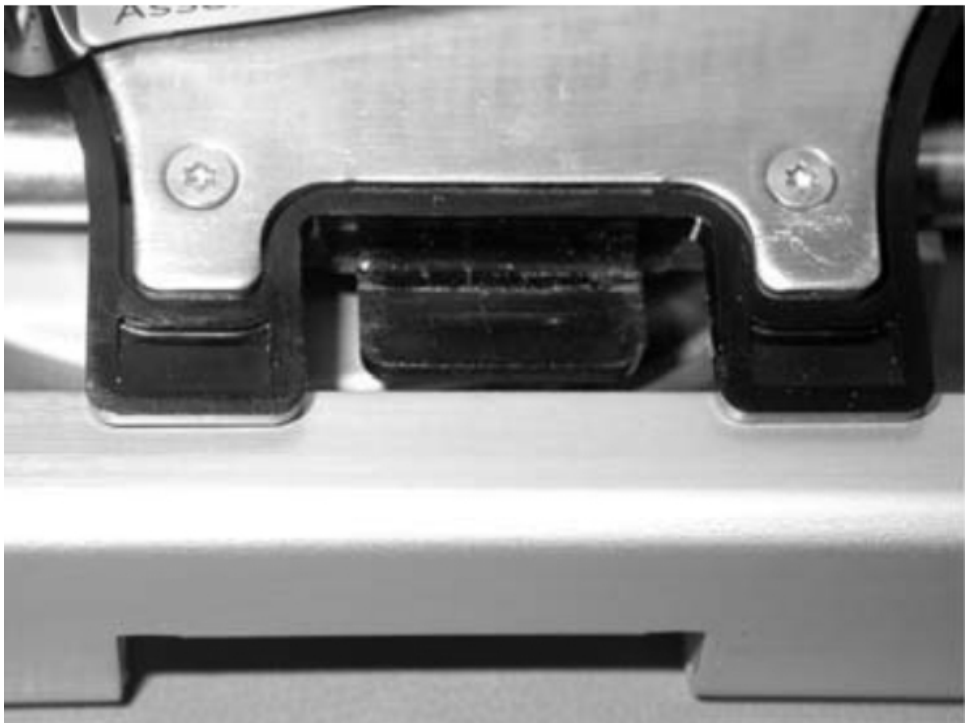

Figure 7-119. Align slot to the sheet metal edge

2) Slide the picker over the sheet metal edge on the M2 Robot Assembly, as shown in Figure 7-120

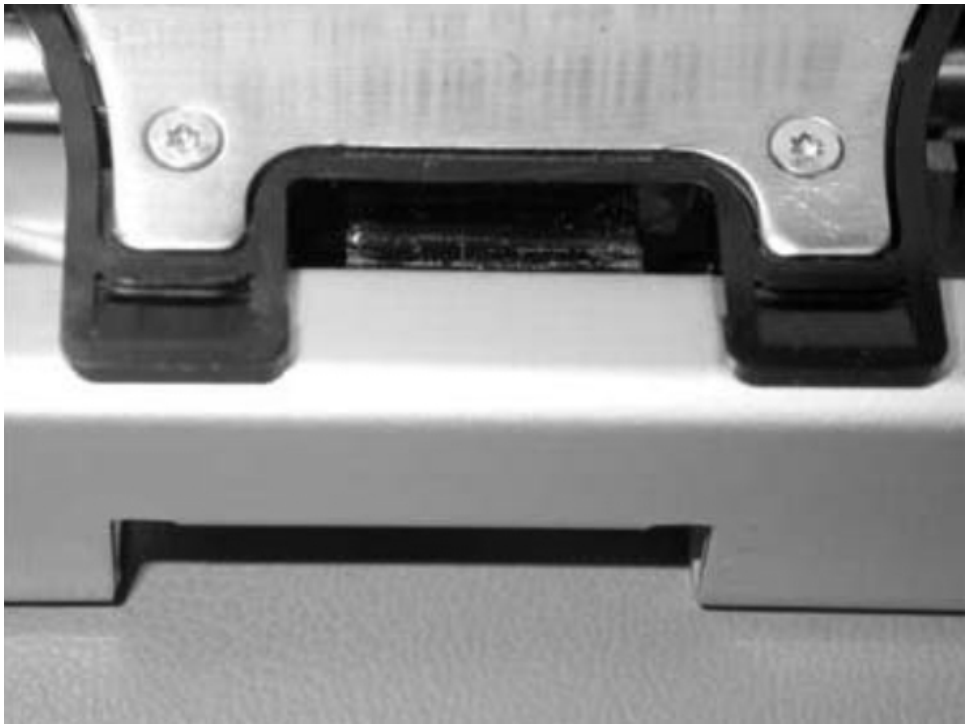

Figure 7-120. Slide slot over edge

4. Lower and latch the Picker Assembly to the M2 Robot Assembly.

a. Locate the release level on the underside of the Picker Assembly. While holding the release lever in the forward position, lower the Picker Assembly onto the M2 Robot Assembly. (See Figure 7-121).

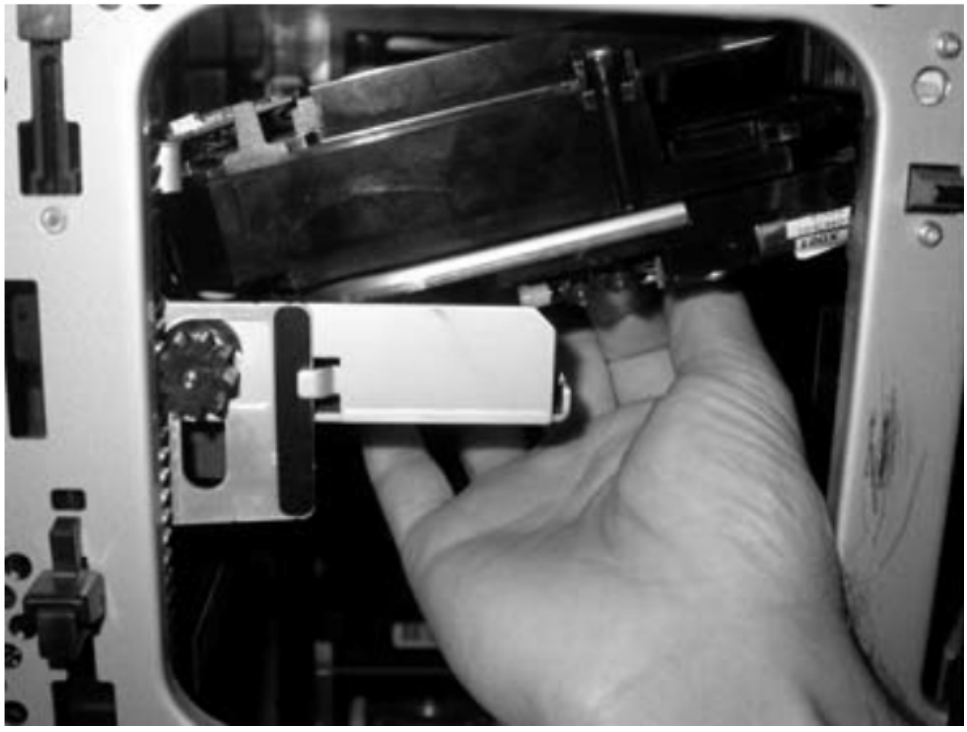

Figure 7-121. Lower the Picker Assembly onto the M2 Robot Assembly

b. Two rollers on the Picker Assembly align with two slots in the M2 Robot Assembly. (See Figure 7-122 on page 7-106). Once the rollers are resting on the M2 Robot Assembly, release the lever.

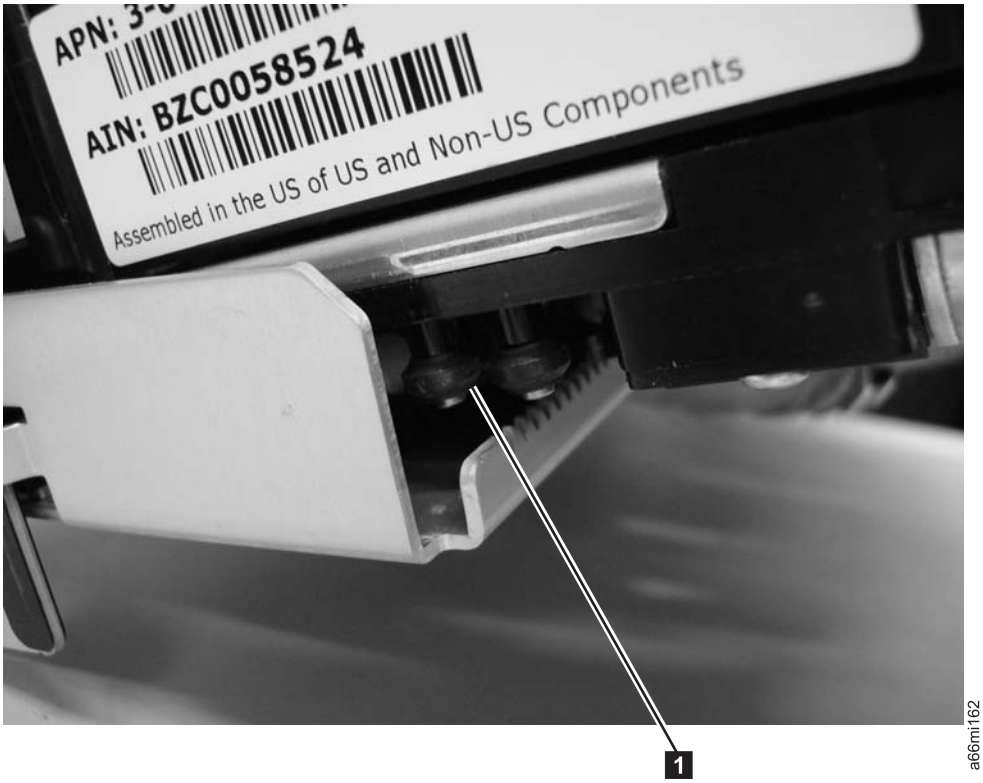

Figure 7-122. Align rollers on the Picker Assembly with slots on the M2 Robot Assembly

c. Verify that the Picker Assembly is fully resting on the M2 Robot Assembly by slowly moving the Picker Assembly toward the rear. If it moves smoothly, installation is complete

5. If necessary, install the I/O Station(s) into the library.
6. Close the Access door, then the I/O Station door.
7. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Removing/Replacing a Storage Column

Storage columns, like the cartridge magazine(s) in the I/O Station, store tape cartridges that are placed within the library.

Removing a Storage Column

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.
2. Perform one of the following:
   - For a 5U library, perform "Removing the M2 Robot Assembly from the Library" on page 7-77.
   - For a 14U library, position the Y-axis/Picker Assembly into the control module if you are removing storage columns from the expansion module, or position the Y-axis/Picker Assembly into the expansion module if you are removing storage columns from the control module.
3. Firmly grasp the storage column. Always begin by removing the front column first. Then remove the remaining column(s).

   Important: Remember the order in which the columns were removed. Replace the columns in their original location.

4. Pull the storage column toward the front of the library (**1** in Figure 7-123) to disengage the locking tabs on the back of the column.

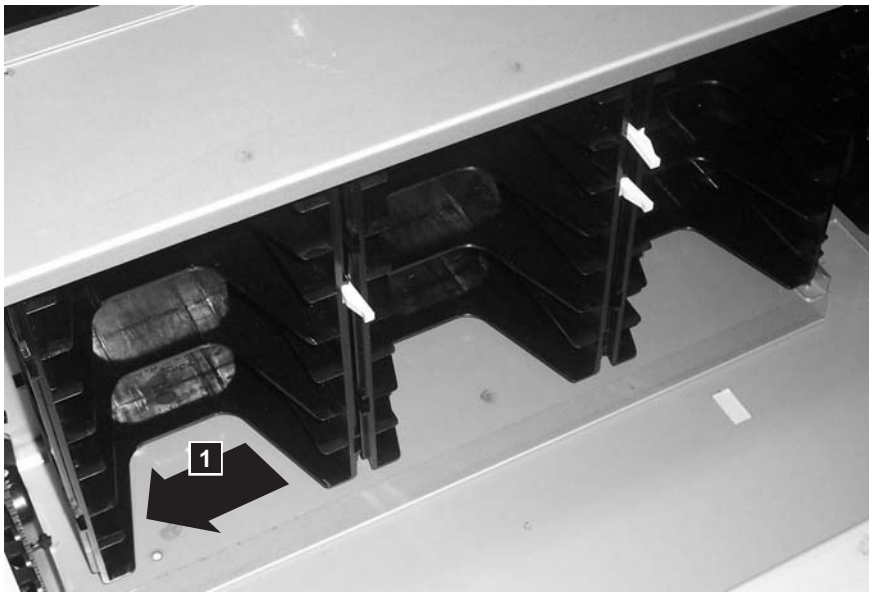

Figure 7-123. Removing a storage column

5. Pull the column straight out of the side wall of thechassis.
6. Repeat this procedure for each column.

Replacing a Storage Column

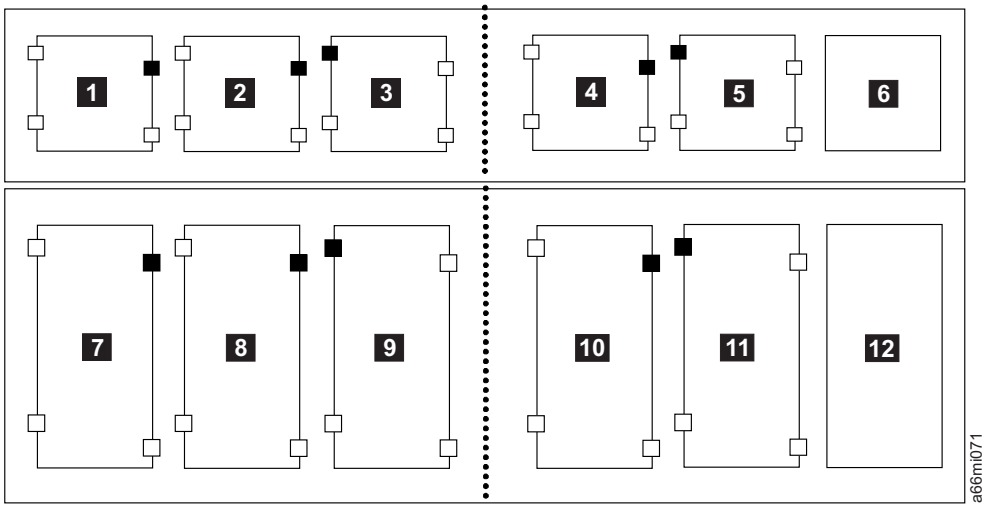

Figure 7-124. Correct fiducial placement

1	Control module/left front column	**7**	Expansion module/left front column
2	Control module/left middle column	**8**	Expansion module/left middle column
3	Control module/left rear column	**9**	Expansion module/left rear column

4	Control module/right rear column	10	Expansion module/right rear column
5	Control module/right middle column	11	Expansion module/right middle column
6	Control module/I/O Station	12	Expansion module/I/O Station

1. Install the new fiducial on the storage column.
   a. Verify the correct position for the fiducial on the storage column by referring to the small black squares on the larger rectangles in Figure 7-124 on page 7-107.
   b. Insert the new fiducial by sliding it into the slot until it locks into place (1 in Figure 7-125).

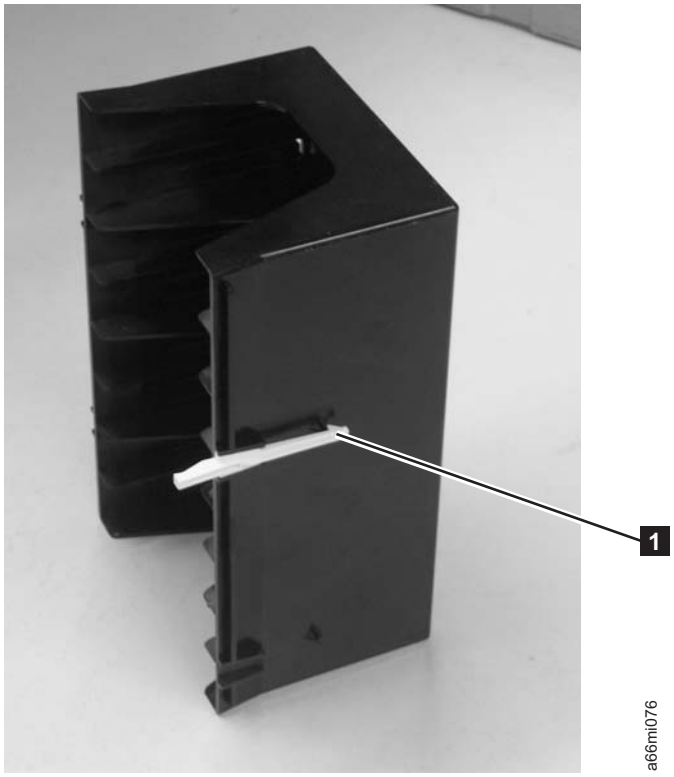

Figure 7-125. Fiducial on storage column

2. Insert the storage column straight into the side wall of the chassis.

   Important: Replace the columns in their original location. Always begin by replacing the rear column first. Then replace the middle and front columns.

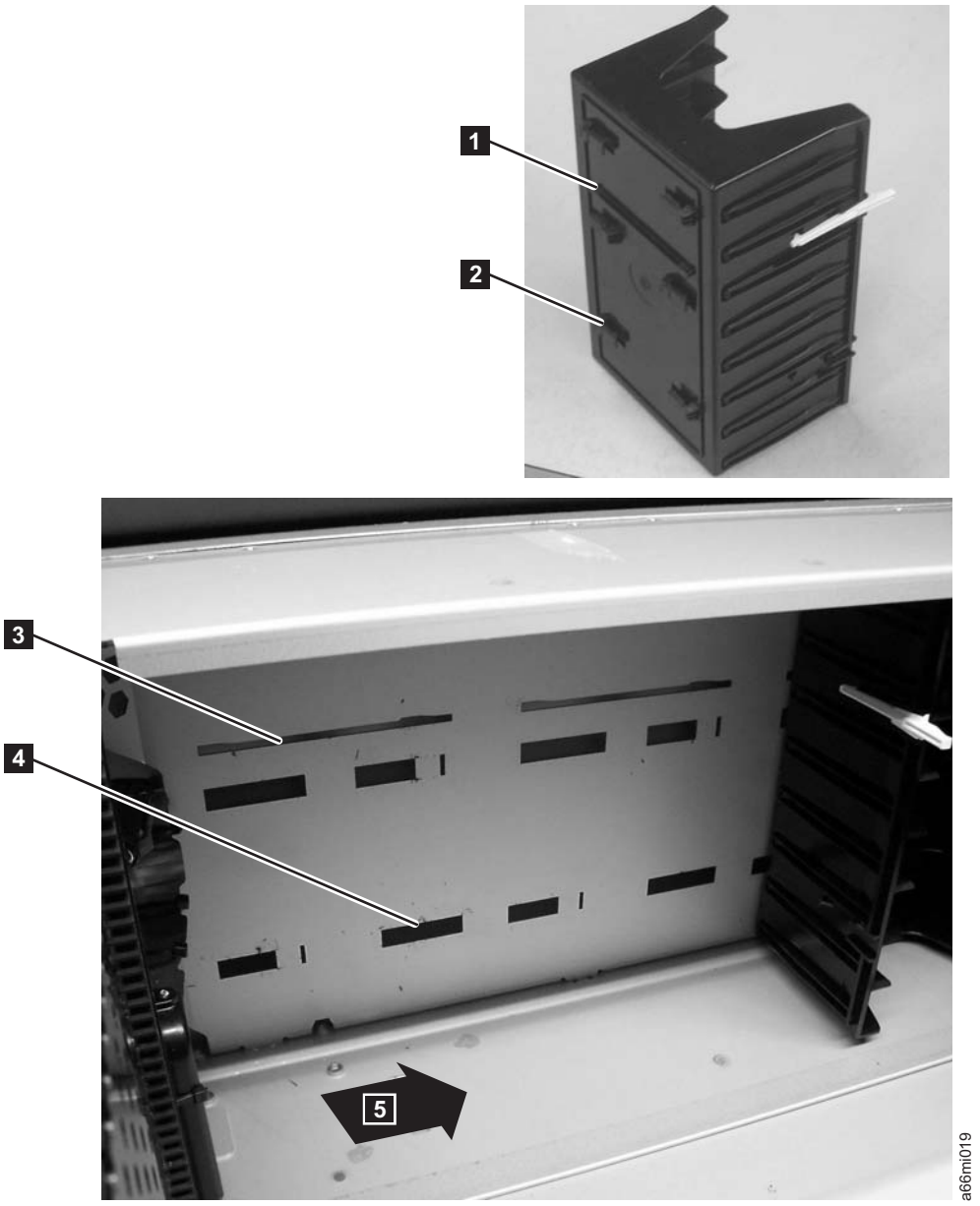

Figure 7-126. Replacing a Storage Column

1	Tab 1 on a storage column	3	Slot 1 in the library chassis wall in a storage column position
2	Tab 2 on a storage column	4	Slot 2 in the library chassis wall in a storage column position

3. Ensure correct orientation by inserting:
   a. Tab 1 (in Figure 7-126) into slot 3 (in Figure 7-126)
   b. Tab 2 (in Figure 7-126) into slot 4 (in Figure 7-126)
4. Push the column towards the rear of the library (5 in Figure 7-126) to engage the locking tabs on the back of the column.
5. Repeat this procedure for each column.
6. For a 5U library, perform "Replacing the M2 Robot Assembly" on page 7-79.

Cable Spool Assembly

The movement of the Y-axis Assembly is controlled by the Cable Spool. The cable spool and Y-carriage assembly enable the picker to move up and down the span of the library, from one module to another. The cable spool is housed in the control module. In order to remove the cable spool, you must also remove the Y-carriage assembly.

There are two versions of the cable spool assembly (see “Cable Spool Assembly” on page 3-9). Although the versions look different, they are completely interchangeable, and the remove/replace procedures are the same. Either spool may be in the library and you may receive either as a Field Support Unit (FRU). The part number for both is the same.

Preparing the Library

1. Power off the library. When the library is powered off, the robot assembly slowly falls to rest in the lowest module of the library.
2. Park the robot assembly in the control module. Before unstacking the library, the robot assembly must be placed in the control module.
   a. Open the I/O station and access doors of each module.
   b. Using your hands, gently lift the robot assembly into the control module. The robot assembly should glide slowly and with some resistance.

      CAUTION:
      Support the robot assembly by holding onto the broad metal X-axis base plate. Lifting the robot by the thin metal rod will bend the rod. Lifting the robot by the black plastic picker body can damage the robot.
   c. After raising the robot assembly to the approximate middle of the control module, hold it in place with one hand and, using your other hand, move the parking tab to the "parked" position (**Model 1 parking tab**: swivel toward you; **Model 2 parking tab**: counter-clockwise direciton). The metal parking tab is located at the bottom of column 1.
   d. Gently release the robot assembly to rest on the parking tab.

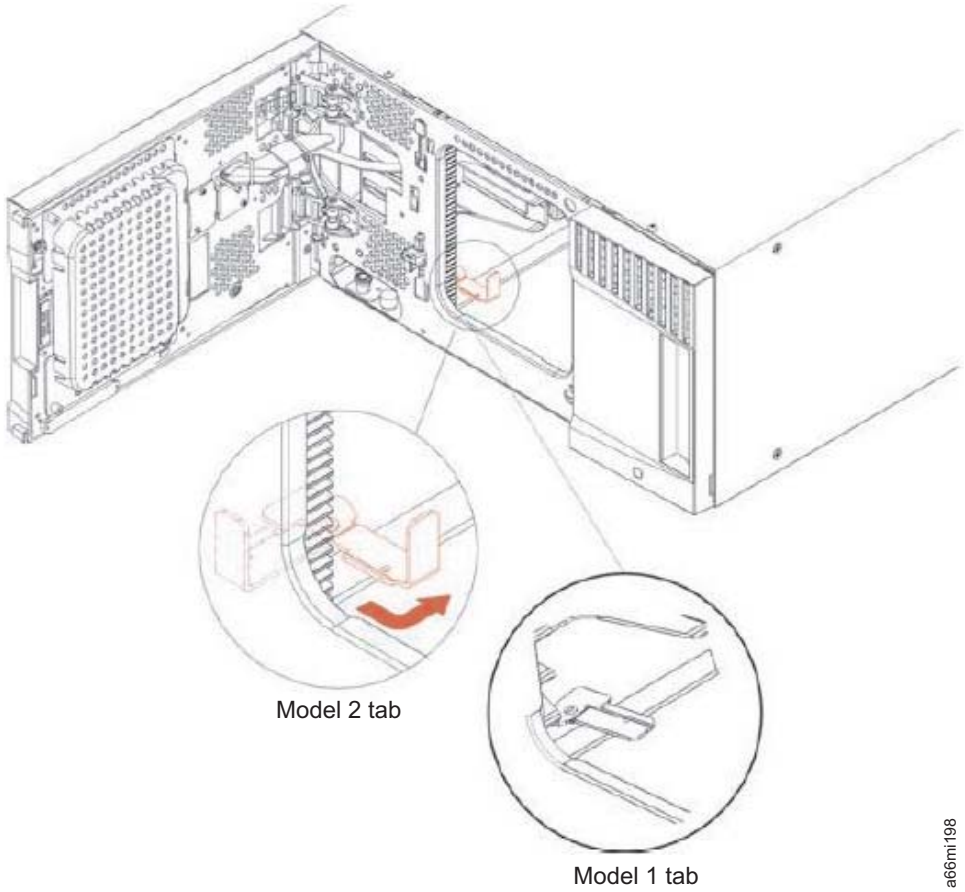

Figure 7-127. Releasing the robot assembly to rest on the parking tab

3. Optional: Unstack the control module from the library, following the steps below:

   Note: Unstacking the control module is not required, but may be helpful if the library is tall or if there is not enough room above the control module to remove the top cover and the robot.

   Note: Before removing the control module, you must first remove all expansion modules (if any) that are located above the control module.

   DANGER

   WITHOUT TAPE DRIVES, TAPE CARTRIDGES, OR POWER SUPPLIES, A 5U CONTROL MODULE WEIGHS APPROXIMATELY 60 LBS. A9U EXPANSION MODULE, WITHOUT TAPE DRIVES, TAPE CARTRIDGES, OR POWER SUPPLIES, EXCEEDS 65 LBS. TO AVOID SEROUS INJURY, AT LEAST TWO PEOPLE ARE REQUIRED TO SAFELY LIFT THE MODULES.

Removing the Cable Spool Assembly

Note: Unstacking the control module is not required, but may be helpful if the library is tall or if there is not enough room above the control module to remove the top cover and the robot.

Note: Before removing the control module, you must first remove all expansion modules (if any) that are located above the control module.

1. To remove the Control Module, perform one of the following procedures:
   - "Removing a 5U Library (Control Module) from a Rack" on page 7-4
   - "Removing a Control Module from a Standalone or Rack-mounted Library (14U or larger)" on page 7-5
2. If the control module's top cover plate is still in place, remove it now with a Phillips screwdriver.

   Optional: Using the T10 TORX screwdriver, remove the side cover panel on the left side of the control module. Removing the side cover panel is not required, but doing so makes it easier to remove the cable spool.
3. Remove the Y-axis/Picker assembly. (See "Removing the M2 Robot Assembly from the Library" on page 7-77).
4. Remove the Storage Columns on the left side of the control module (see "Removing a Storage Column" on page 7-106).
5. Disconnect the Cable Spool Assembly connector (**1** in Figure 7-128 on page 7-113) from the J11 connector on the distribution board.

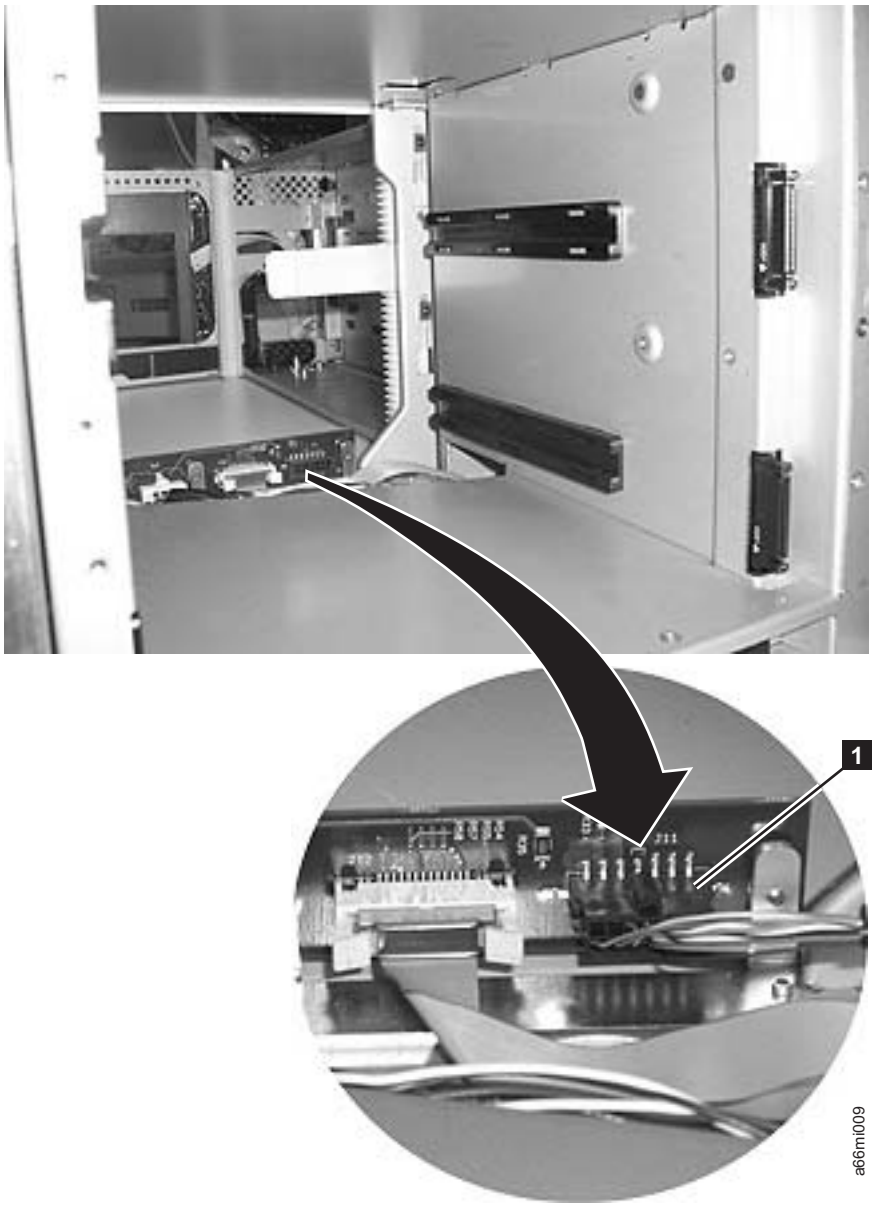

Figure 7-128. Unplugging the Cable Spool Assembly (library shown in upright position)

6. From the front of the control module, hook the Cable Spool flat cable handle (**3** in Figure 7-129 on page 7-114) around the black plastic guide peg (**2** in Figure 7-129 on page 7-114). This will rotate the small terminal board (**1** in Figure 7-129 on page 7-114) so that it will not contact the frame when the assembly is removed from the enclosure.

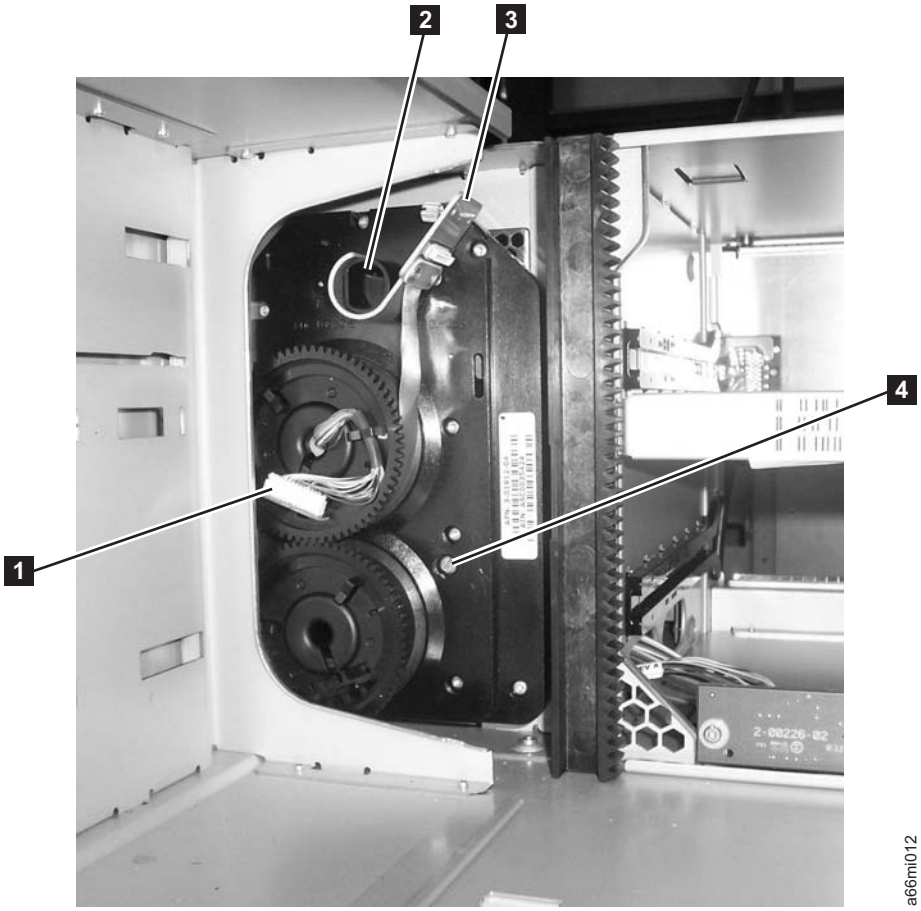

Figure 7-129. Securing Spooler flat cable

7. Loosen the T10 Torx retaining screw (**4** in Figure 7-129) until the Cable Spool Assembly is loosened from the enclosure.

   Note: Do not remove the screw, only loosen it.

8. Remove the Cable Spool Assembly from the control module. Carefully route the cable (**1** in Figure 7-130 on page 7-115) disconnected from the distribution board through the holes in the enclosure to avoid damage to the cable.

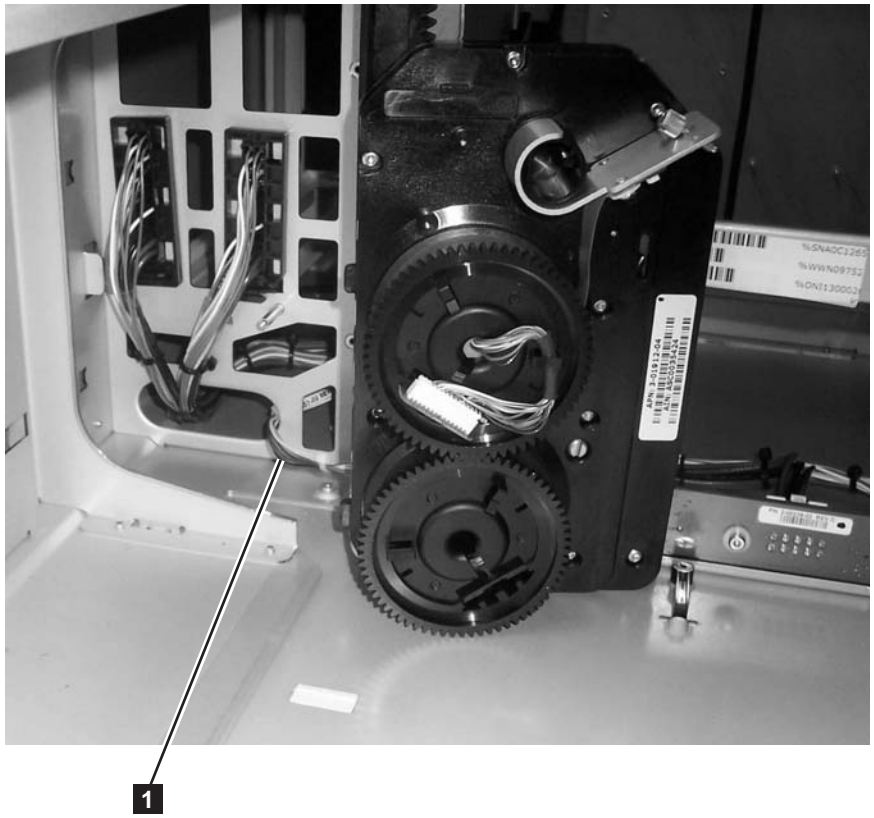

Figure 7-130. Cable Spool cable routing through enclosure wall

Replacing the Cable Spool Assembly

1. Insert the Cable Spool Assembly into the control module. Carefully route the cable disconnected from the distribution board through the holes in the enclosure (**1** in Figure 7-130) and to the left of the screw stand-offto avoid damage to the cable.
2. Carefully insert the plastic tabs (**1** in Figure 7-131 on page 7-116) on the Cable Spool Assembly into the slots (**2** in Figure 7-131 on page 7-116) in the enclosure sidewall.

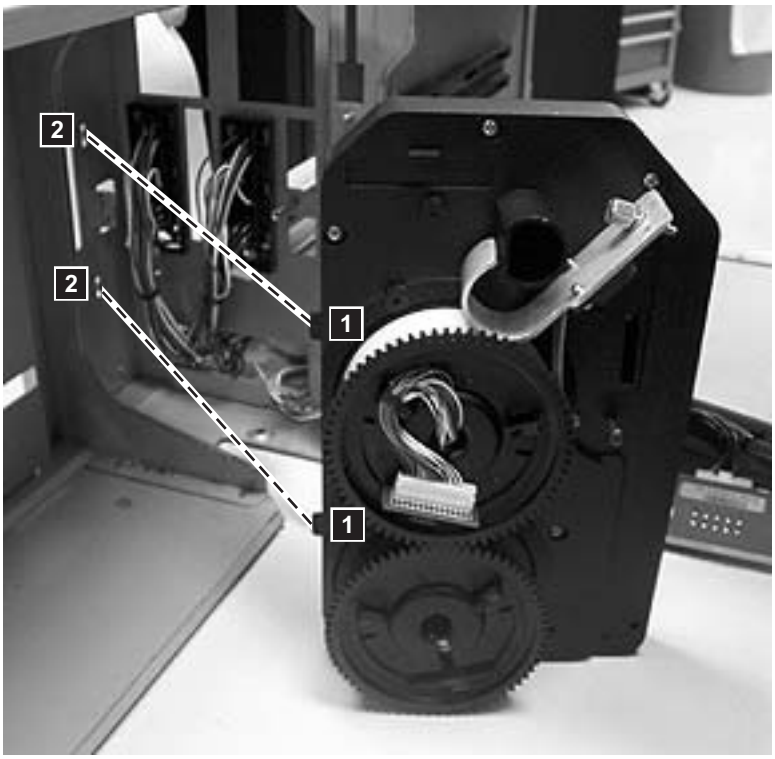

Figure 7-131. Cable Spool Assembly tabs

3. Tighten the T10 Torxretaining screw (**4** in Figure 7-129 on page 7-114) until the Cable Spool Assembly is secured to the enclosure.
4. Connect the Cable Spool connector (**1** in Figure 7-128 on page 7-113) to the J11 connector on thedistribution board.
5. Replace the Storage Columns. See "Replacing a Storage Column" on page 7-107.
6. Replace the Y-axis/Picker Assembly. See "Replacing the M2 Robot Assembly" on page 7-79.
7. If they were removed, replace the top cover and left side cover.
8. If your library is installed in a rack, perform one of the following procedures:
   - "Replacing a 5U Library (Control Module) in a Rack" on page 7-4
   - "Replacing a Control Module in a Standalone or Rack-mounted Library (14U or larger)" on page 7-11
9. Perform "Returning a Library or Library Module to Normal Operations after Repairs" on page 7-3.

Gear Rack

The Y-axis Assembly uses the Gear Racks (one in front, one in back) to move the Picker and Bar Code scanner within the library.

Removing a Front Gear Rack

1. Lay the library module on the left side (from front).
2. Remove the bottom cover of the module, if necessary.

3. There is a small metal tab in the chassis frame (1 in Figure 7-132) that prevents the gear rack from falling down too far when the locking mechanism is released. Bend the tab out slightly so the gear rack can be removed.
4. Slightly push up and pinch the gear rack locking mechanism to unlock the front gear rack (4 in Figure 7-132).

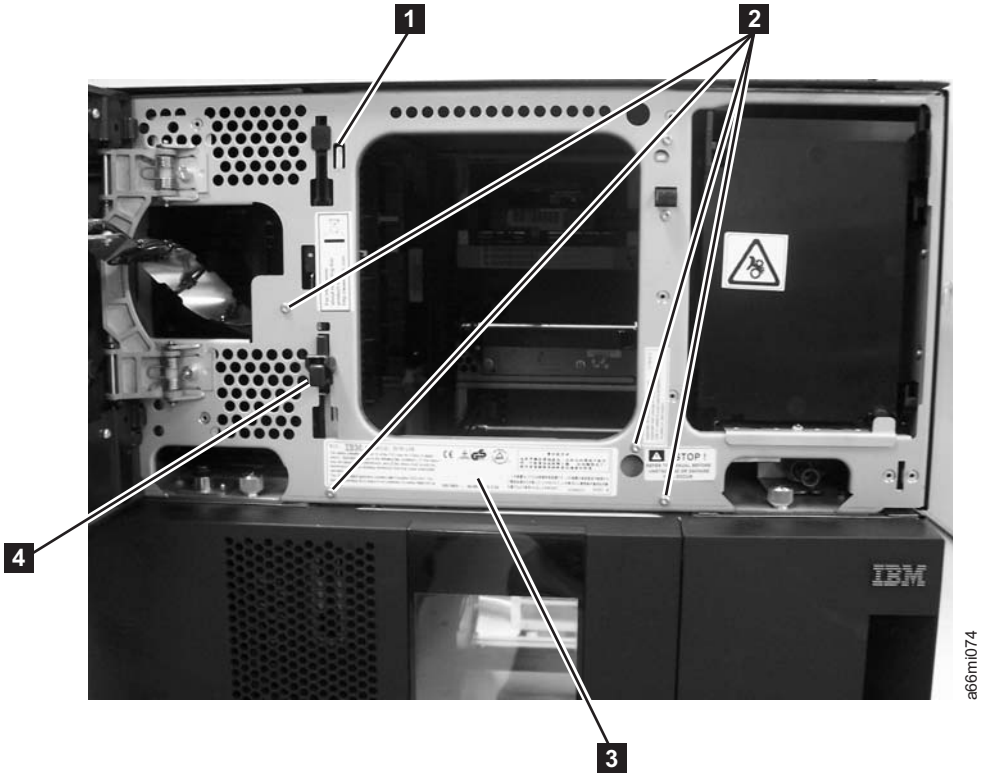

Figure 7-132. Front gear rack

5. While pinching the gear rack locking mechanism (4 in Figure 7-132), push the gear rack down, then release your hold on the locking mechanism.
6. Remove the gear rack by pulling the black tab and the locking mechanism through the keyhole slots in the chassis frame.

   Note: Don't lose the spring (2 in Figure 7-133 on page 7-118) that is recessed in the gear rack slot.

Replacing a Front Gear Rack

1. Lay the library module on the left side (from front).
2. Using your thumb, push the metal slide (4 in Figure 7-133 on page 7-118) toward the gear rack locking mechanism (3 in Figure 7-133 on page 7-118) and hold it in place while inserting the black tab (1 in Figure 7-133 on page 7-118) and locking mechanism into the keyhole slots in the library chassis.

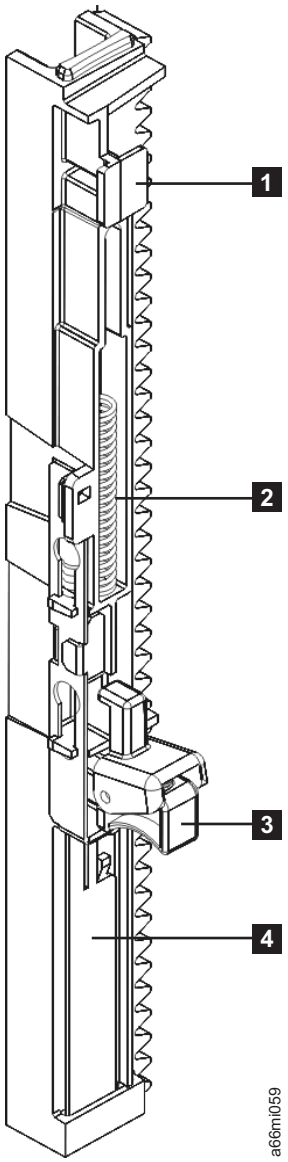

Figure 7-133. Gear rack (detail)

3. While pinching the gear rack locking mechanism, push up on the gear rack, then release your hold on the locking mechanism.
4. Bend the small metal tab (**1** in Figure 7-133) in slightly to prevent the gear rack from moving down too far.
5. Replace the bottom cover of the module, if necessary.
6. Return the module to its correct, upright position.

Removing a Rear Gear Rack

1. Lay the library module on the left side (from front).
2. Remove the top and bottom covers of the module, if necessary.
3. There is a small metal tab in the chassis frame (**1** in Figure 7-132 on page 7-117) that prevents the gear rack from falling down too far when the locking mechanism is released. Bend the tab out slightly so the gear rack can be removed.

4. Slightly push up and pinch the gear rack locking mechanism (1 in Figure 7-134) to unlock the gear rack. The gear rack is spring-loaded against the tab and will be removed through the bottom of the module.

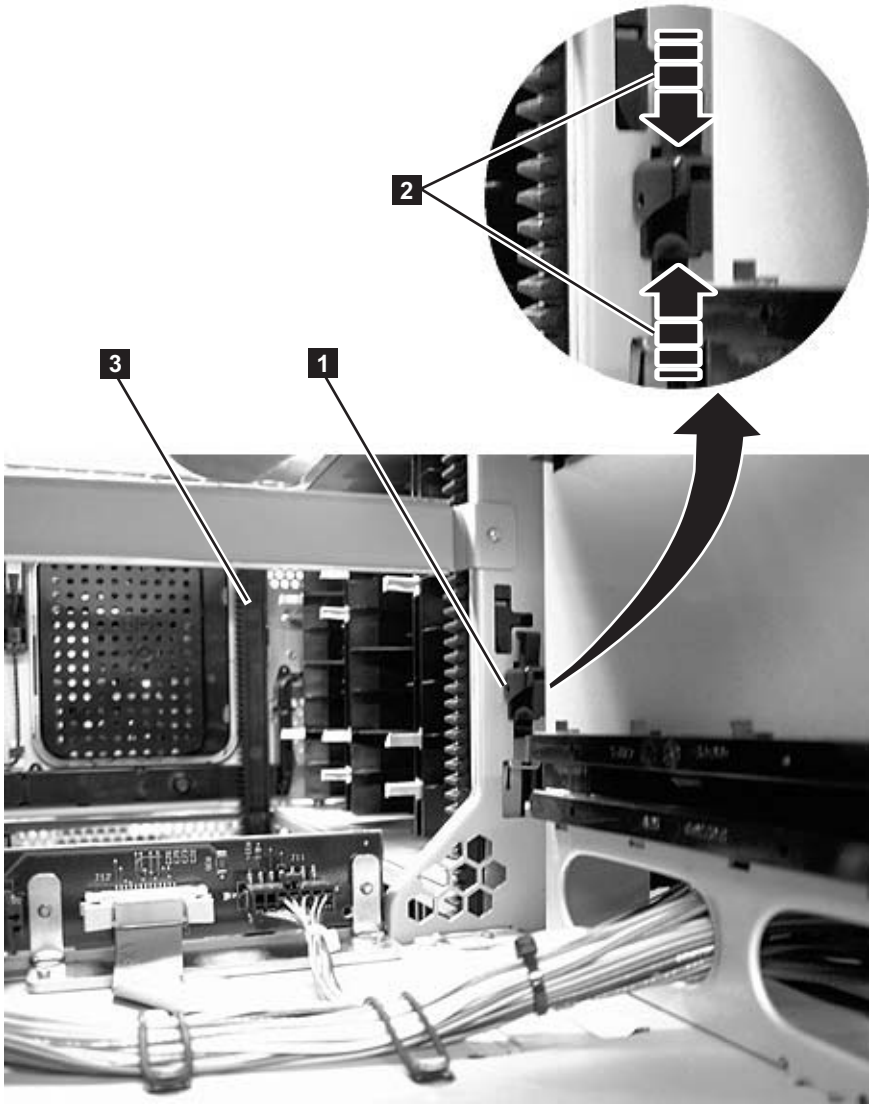

Figure 7-134. Removing a gear rack

5. While pinching the gear rack locking mechanism (2 in Figure 7-134), push the gear rack down then release your hold on the locking mechanism.
6. Remove the gear rack by pulling the black tab (1 in Figure 7-135 on page 7-120) and the gear rack locking mechanism (3 in Figure 7-135 on page 7-120) through the keyhole slots.

   Note: Don't lose the spring (2 in Figure 7-135 on page 7-120) that is recessed in the gear rack slot.

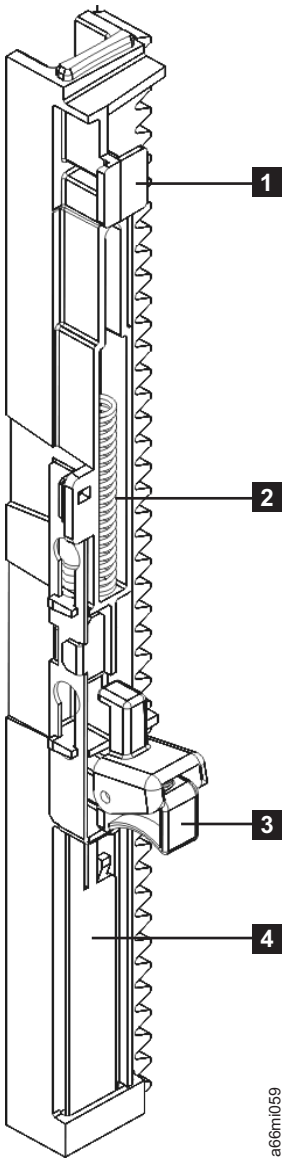

Figure 7-135. Gear rack (detail)

7. Return the module to its correct, upright position.

Replacing a Rear Gear Rack

1. Lay the module on the left side (from front).
2. Using your thumb, push the metal slide (**4** in Figure 7-135) toward the gear rack locking mechanism (**3** in Figure 7-135) and hold it in place while inserting the black tab (**1** in Figure 7-135) and locking mechanism into the keyhole slots in the library chassis.

Figure 7-136. Rear gear rack location on chassis

3. While pinching the gear rack locking mechanism, push up on the gear rack, then release your hold on the locking mechanism.
4. Bend the small metal tab (**1** in Figure 7-133 on page 7-118) in slightly to prevent the gear rack from moving down too far.
5. Replace the covers of the module, if necessary.
6. Return the module to its correct, upright position.

Removing Internal Cables and Boards

Special tools required for this procedure:

- T6 Torx wrench for D-Shell connectors on BCB cables
- T8 Torx wrench for BCB board
- 5 mm (3/16 inch) wrench for the stand-off behind cable spool assembly
- 4.5 mm (3/16 inch) wrench for DSIB board

Important:

- Prior to replacing all of the internal cables and boards you should visually check, and reseat if necessary, all of the internal connectors. (see "Internal Cables" on page 6-33).
- It may not be necessary to replace all of the cables and boards in this procedure. Depending on your failure symptoms and discussions with Technical Support, you may only have to replace a portion of these parts.

1. Perform "Preparing a Library or Library Module for Repairs" on page 7-3.

2. Perform the following CRU procedures using the control module:
   a. "Removing the Library Control Blade/ Compact Flash Assembly" on page 7-45
   b. "Removing a Drive Sled" on page 7-42
   c. "Power Supply (Primary and Redundant)" on page 7-51
3. Perform one of the following procedures:
   - "Removing a 5U Library (Control Module) from a Rack" on page 7-4
   - "Removing a Control Module from a Standalone or Rack-mounted Library (14U or larger)" on page 7-5
4. Remove the top, side, and bottom covers, as necessary, from the control module.
5. Perform the following FRU procedures using the control module:
   a. "Removing an I/O Station" on page 7-34
   b. "Removing the I/O Station Lock Assembly" on page 7-35
   c. "M2 Robot Assembly" on page 7-77
   d. All library magazines. "Removing/Replacing a Storage Column" on page 7-106
   e. "Removing a Front Gear Rack" on page 7-116
6. Remove the cable assembly from the Operator Control Panel (OCP) to the Backplane Connector Board (BCB).
   a. Remove the cable retainers (see **1** in Figure 7-137).

      Note: The cable retainers may be black rubber 'O' rings as shown, or white plastic beaded cable ties. If they are the white cable ties, it will be necessary to cut them off and replace them with new cable retainers included in the new FRU kit.

   b. Remove the 2 screws from under the cable guide (see **2** in Figure 7-137) near the I/O Station lock assembly.

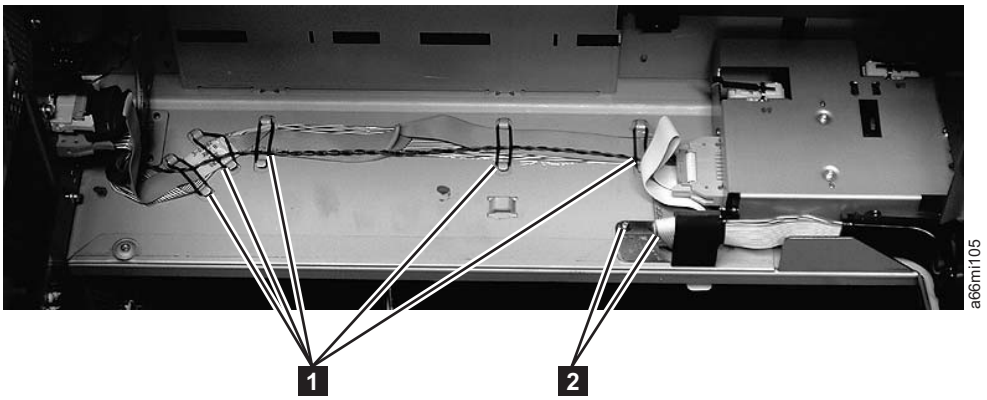

Figure 7-137. Cable assembly from the Operator Control Panel to the Backplane Connector Board

   c. Unplug cable connectors J9 (see **2** in Figure 7-138 on page 7-123), J16 (see **3** in Figure 7-138 on page 7-123), and J15 (see **4** in Figure 7-138 on page 7-123) from the BCB.

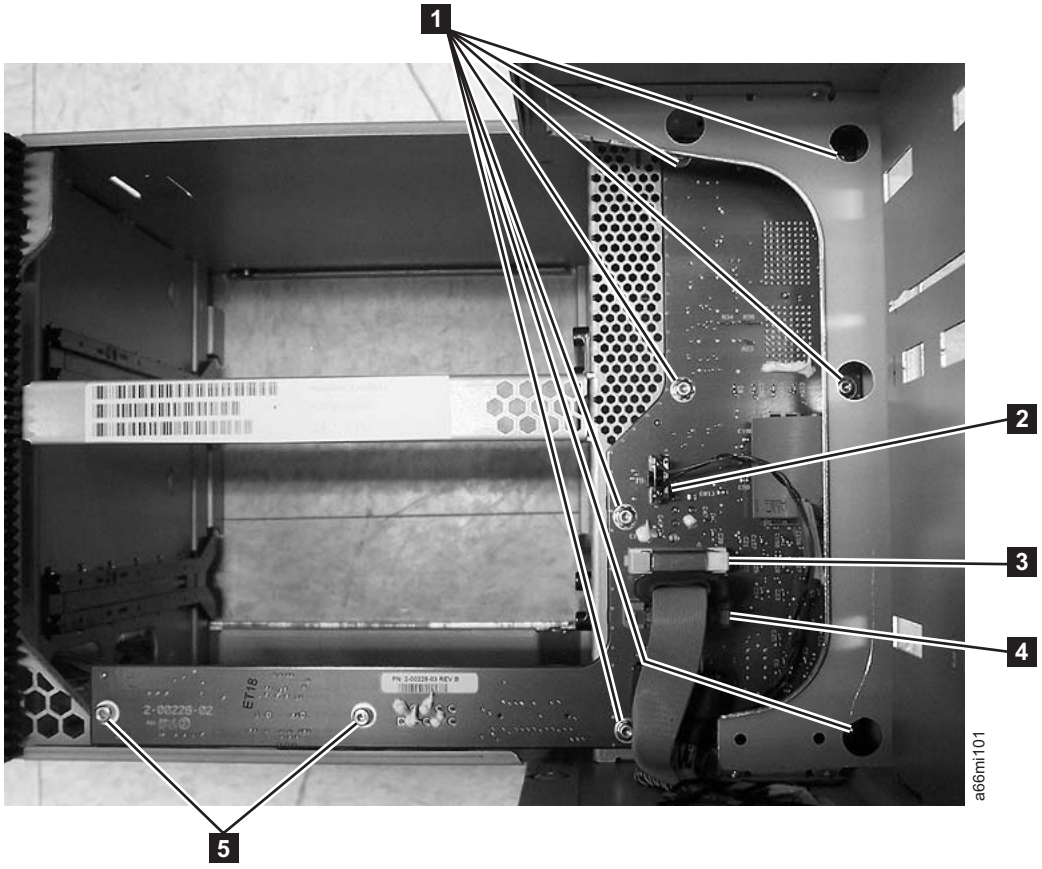

Figure 7-138. Backplane Connector Board (BCB), Front View

d. Remove the black protective cover from the back of the Operator Panel.

e. Remove cable connectors J36 (see 3 in Figure 7-139 on page 7-124), J35 (see 5 in Figure 7-139 on page 7-124), and J32 (see 7 in Figure 7-139 on page 7-124) from the Operator Panel board.

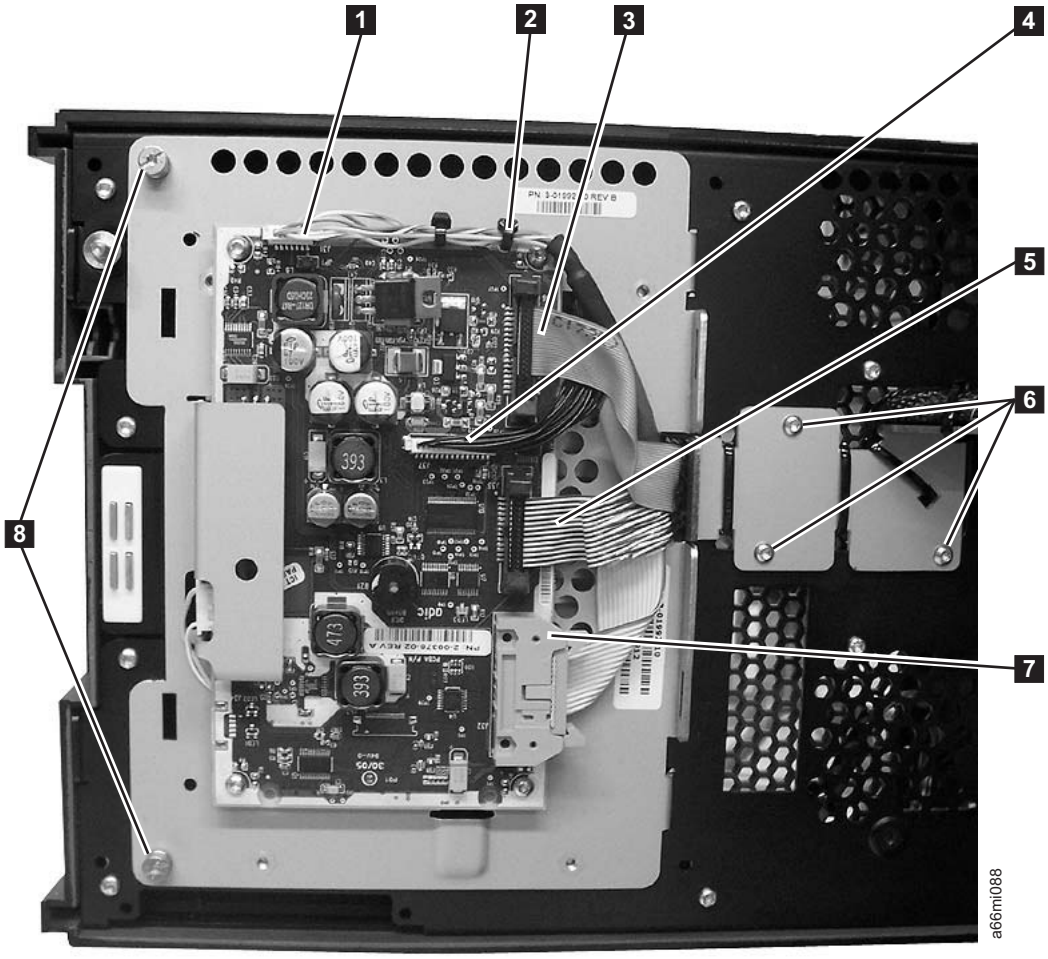

Figure 7-139. Operator Panel Cable Connectors

f. Remove the 3 screws (see **6** in Figure 7-139) from the cable retainer bracket on the back of the door.

g. Remove the 4 screws (see **2** in Figure 7-140 on page 7-125) from the front of the door, holding the long plastic cable guide to the door.

Note: The mounting holes in the new plastic cable guide may not match correctly with the screw holes in the door. If they do not match correctly, it will be necessary to transfer the plastic guide from the old cable assembly to the new cable assembly. Cut the cable ties to remove the plastic guides from both the old cable and the new cable. Use the new cable ties in the FRU kit to attach the old guide to the new cable.

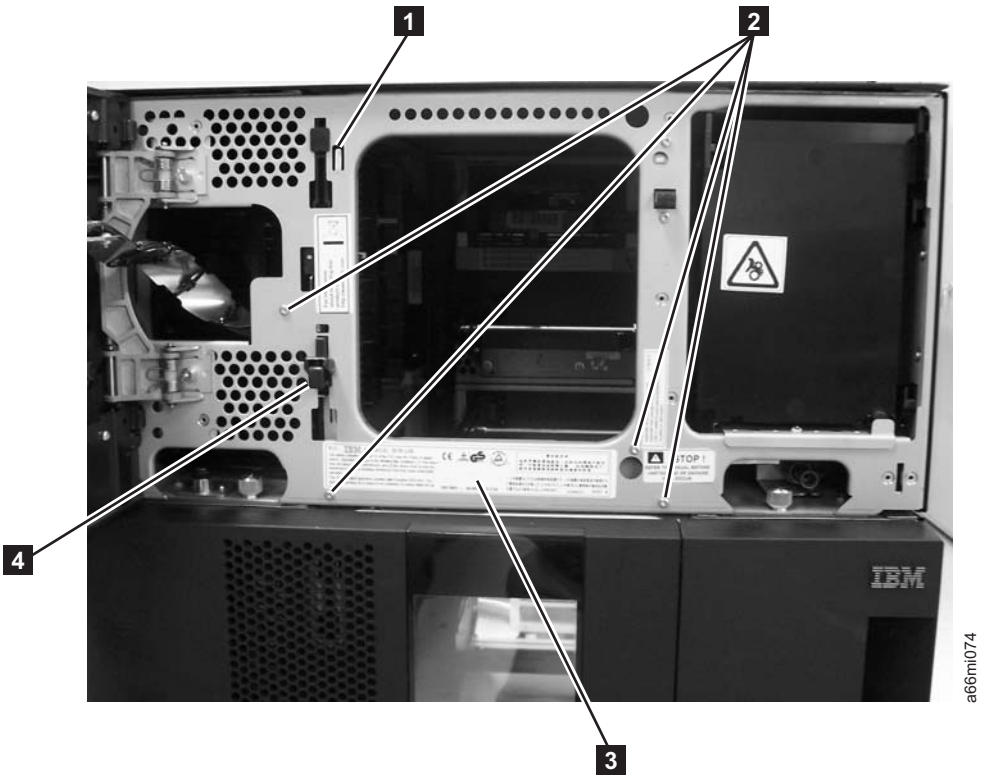

Figure 7-140. Four screws on front of door and plastic cable guide

h. Carefully remove the cable assembly from the enclosure.

7. Remove the cable assemblies between the Power Supplies, the Drive Sled Interface Board (DSIB), and the Backplane Connector Board (BCB) by following these procedures:
   a. Remove the "Cable Spool Assembly" on page 7-110.
   b. Remove the hex stand-off (see **1** in Figure 7-141 on page 7-126) from behind the Cable Spool Assembly. This requires a 5 mm (3/16-inch) wrench.

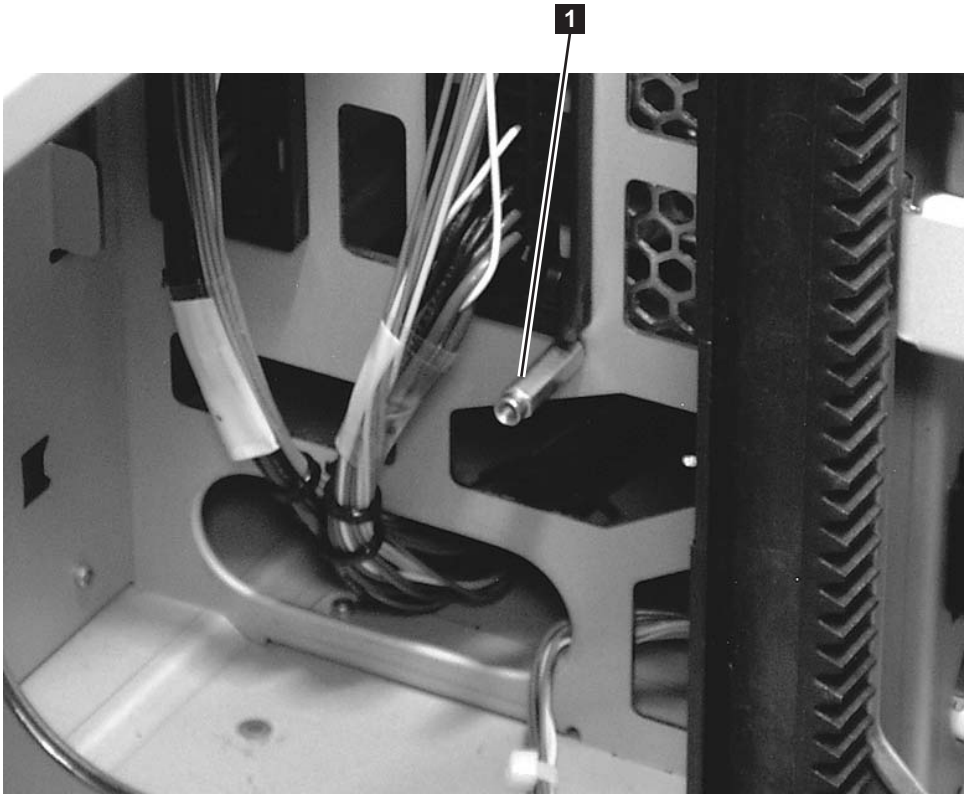

Figure 7-141. Hex stand-off behind the Cable Spool Assembly

c. Remove the cable retainers (**5** in Figure 7-142 on page 7-127 and **6** in Figure 7-143 on page 7-127).

Note: The cable retainers may be black rubber 'O' rings as shown, or white plastic beaded cable ties. If they are the white cable ties, it will be necessary to cut them off and replace them with new cable retainers included in the new FRU kit.

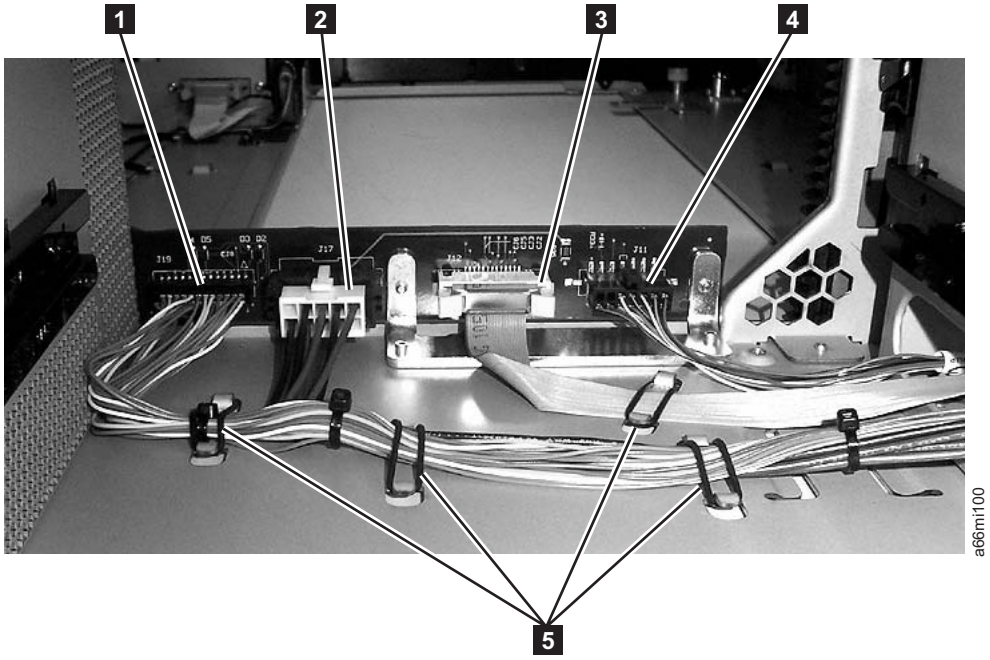

Figure 7-142. Backplane Connector Board (BCB), Rear View

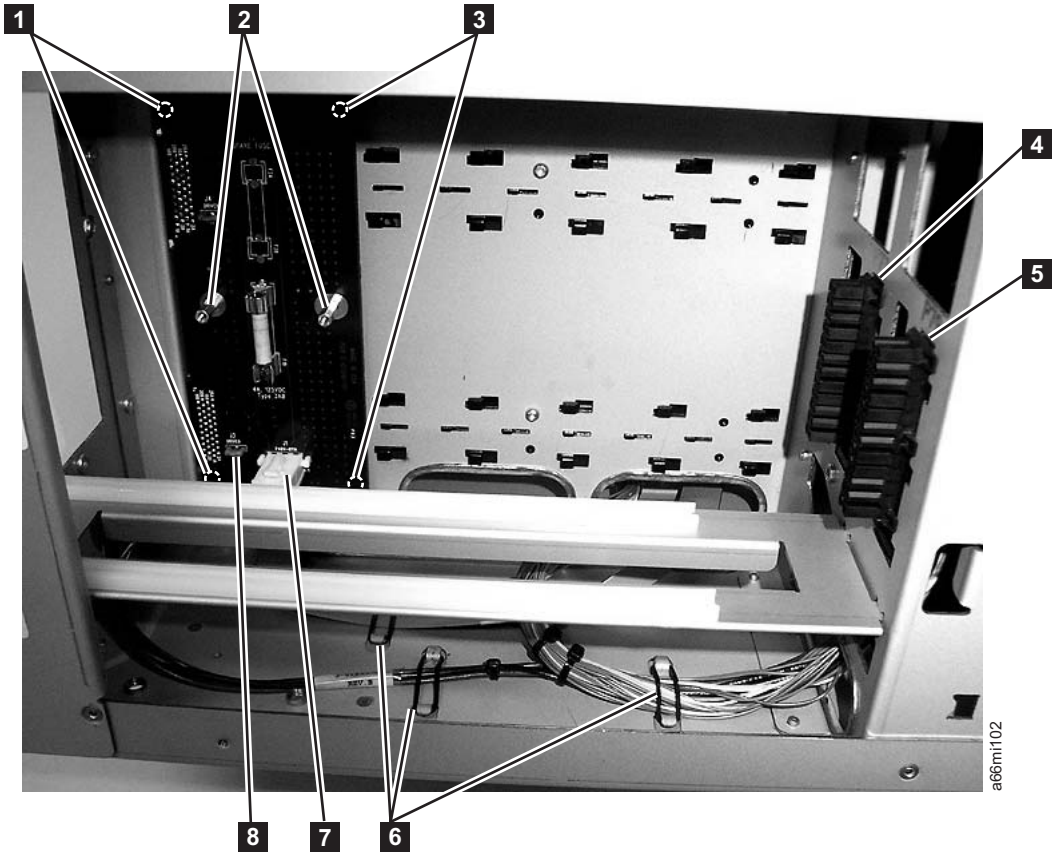

Figure 7-143. Drive Sled Interface Board (DSIB), Side Cover Removed

d. Remove cable connectors J77 (4 in Figure 7-143 on page 7-127) and J79 (5 in Figure 7-143 on page 7-127). Pinch the lower part of the connector, press towards the front and slide down to remove the connector from the frame.

e. Unplug the 2 connectors P17 and P19 from the BCB (see 2 and 1 in Figure 7-142 on page 7-127.

f. Remove the 2 screws (2 in Figure 7-143 on page 7-127) and remove the protective cover over the DSIB.

g. Unplug the 1 power connector P1 (7 in Figure 7-143 on page 7-127) from the DSIB.

h. Carefully remove the cable assembly from the enclosure.

i. Remove the flat cable from the DSIB to the BCB.

1) Unplug connector P2 (8 in Figure 7-143 on page 7-127) from the DSIB.

2) Unplug connector P12 (3 in Figure 7-142 on page 7-127) from the BCB.

3) Remove the flat cable from the enclosure.

8. Remove the Drive Sled Interface Board (DSIB).

a. Remove the 2 hex stand-offs (2 in Figure 7-143 on page 7-127) from the DSIB. This requires a 4.5 mm (3/16-inch) wrench.

b. The DSIB is held to the frame by slotted pins (1 and 3 in Figure 7-143 on page 7-127) in all 4 corners of the board.

1) Using a flat blade screwdriver, carefully pry the 2 front corners of the board (3 in Figure 7-143 on page 7-127) from the mounting pins.

2) Put finger pressure on the drive connectors on the back of the DSIB one at a time, while you move the board back and forth to pull it from the corner mounting pins (1 in Figure 7-143 on page 7-127).

3) Remove the Drive Sled Interface Board (DSIB) from the enclosure.

9. Remove the Backplane Connector Board (BCB).

a. Remove the 2 T8 Torx shoulder screws (5 in Figure 7-138 on page 7-123) holding the lower part of the BCB.

b. Remove the 7 T10 Torx screws (1 in Figure 7-138 on page 7-123) holding the remainder of the BCB.

c. Remove the terminator(s) from the 2 D-shell connectors (2 in Figure 7-144 on page 7-129) on the back of the control module, if necessary.

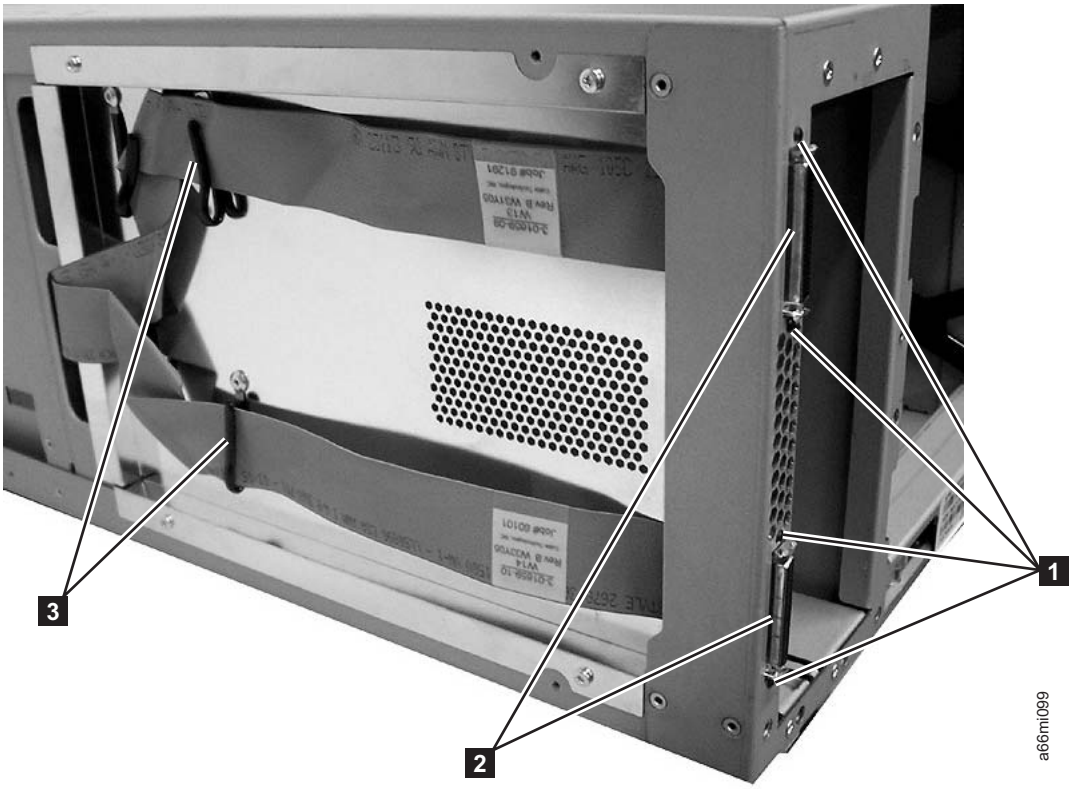

Figure 7-144. D-shell connectors and flat cables, side cover removed

d. Remove the 4 T6 Torx screws (1 in Figure 7-144) holding the 2 D-shell connectors (2 in Figure 7-144) on the back of the control module. Carefully remove the 2 flat cables (3 in Figure 7-144) and D-shell connectors from under the cable retainers on the side of the enclosure.

e. Carefully remove the BCB and cable assembly from the enclosure.

Replacing Internal Cables and Boards

To install the new cables and boards, perform the remove procedure(s) in the reverse order.

Tip: When installing the new BCB it is easier to start the board mounting screws (1 and 5 in Figure 7-138 on page 7-123) if you first stand the control module enclosure on end.

Remove and Replace Drive Power Fuse

Each library module has an external drive power overload fuse that serves as a protective device for all drive sleds installed in that module. The control module has a 4 amp fuse and a 9U expansion module has a 7 amp fuse. The external drive power overload fuse will blow if excessive current is being drawn by the drive sleds.

Removing a Drive Power Fuse

1. Perform “Preparing a Library or Library Module for Repairs” on page 7-3.
2. Remove all power supplies in the library module with the blown drive power overload fuse (see “Removing a Primary Power Supply” on page 7-52).

3. Remove the cover plate (**1** in Figure 7-145) inside the power supply slot.

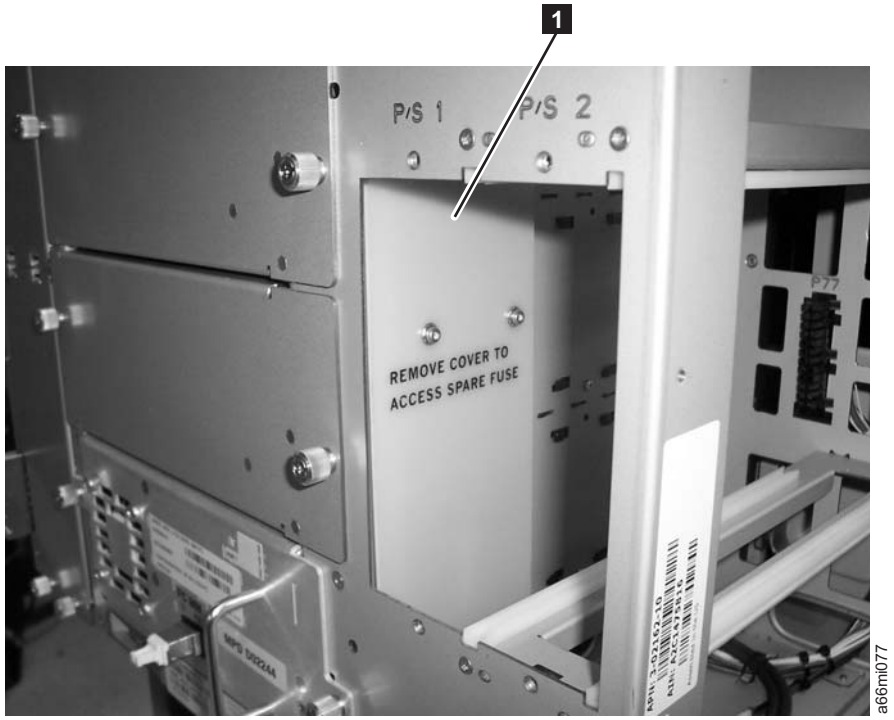

Figure 7-145. Drive power overload fuse cover plate

4. Using a fuse puller, gently remove the blown fuse (**1** in Figure 7-146).

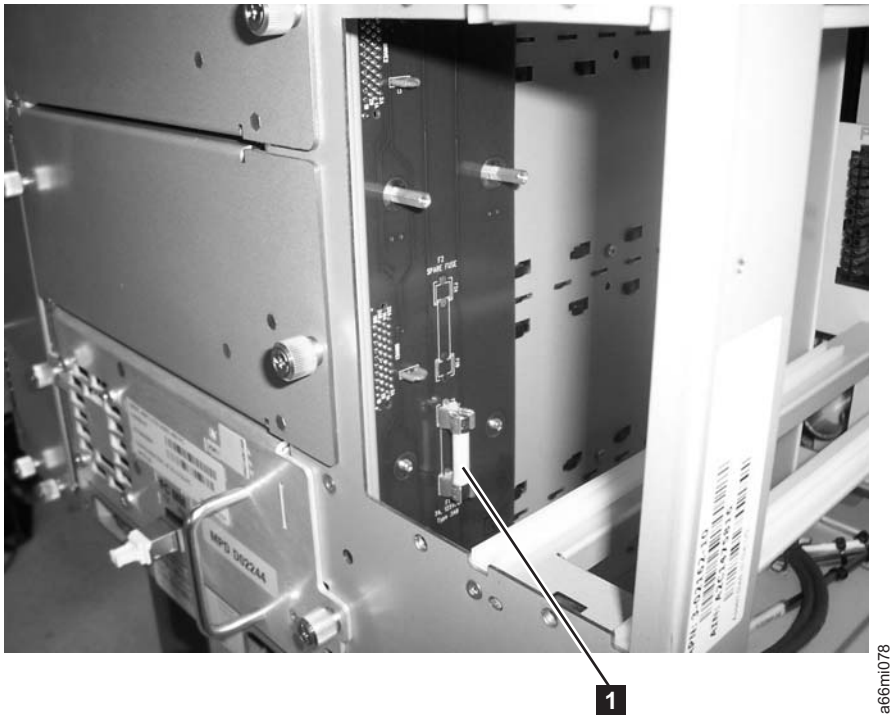

Figure 7-146. Drive power overload fuse

Installing a Drive Power Overload Fuse

1. To install a drive power overload fuse, perform the steps in “Removing a Drive Power Fuse” on page 7-129 in reverse order.
2. For the last step, perform “Returning a Library or Library Module to Normal Operations after Repairs” on page 7-3.

Removing/Installing Library Foot Pads

If your library is currently rack mounted, foot pads must be installed on the bottom of the library chassis before the library can be used as a desktop unit. If your library is currently being used as a desktop unit, foot pads will be installed on the bottom of the library. Foot pads must be removed before the library can be installed in a rack.

Removing Library Foot Pads

To remove the library foot pads:

1. Place the sling that was shipped with your library underneath the library halfway between the front and back feet. Ensure that both sling handles are an equal distance from the sides of the library. Use of the sling is strongly recommended for a 9U module. A 5U module is much lighter in weight, and it may not be necessary to use the sling.
2. Being very careful, lay the library on its side.
3. Using a #2 Phillips screwdriver, remove the foot pads attached to the bottom of the library. Store these parts for future use.
4. Carefully return the library to an upright position on top of the sling.

Installing Library Foot Pads

For a desktop installation, foot pads must be installed on the bottom module of your library. To install the library foot pads:

1. Being very careful, lay the module on its side.
2. Using a #2 Phillips screwdriver, install the foot pads on the bottom of the library chassis. See Figure 7-147 on page 7-132 for foot pad locations.

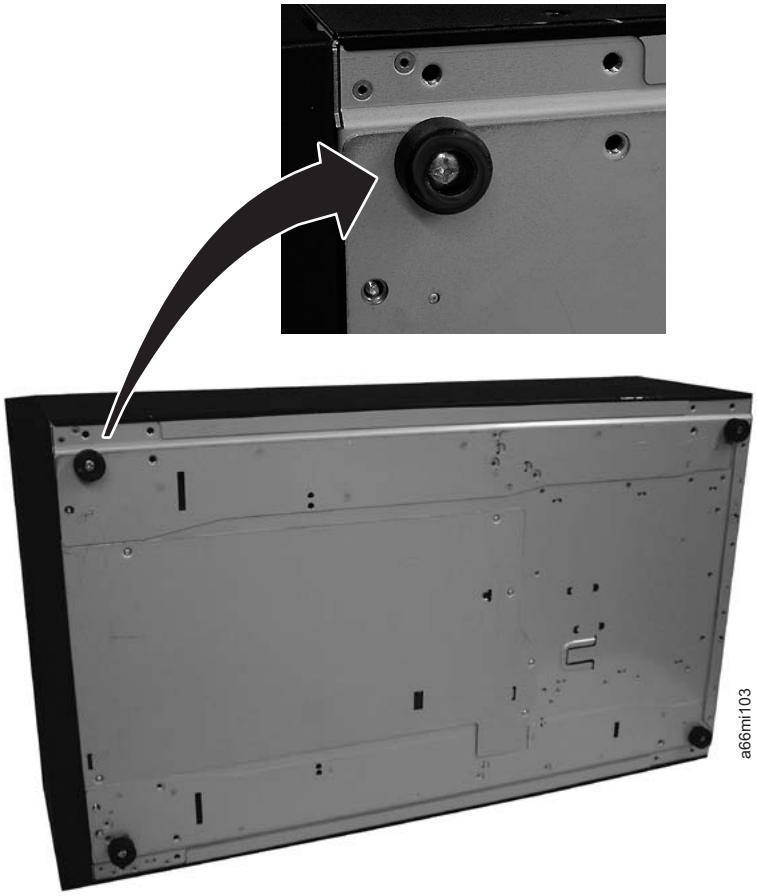

Figure 7-147. Foot pad Locations

3. Carefully return the library to an upright position.
4. Use the lifting sling to place the library module in the desktop location.
5. When you finish these desktop installation steps, store the installation sling in a secure location for possible future use.

Manual Cartridge Removal from a Drive

The purpose of this section is to assist you in determining the condition of the cartridge or the magnetic tape and to direct you to the procedure you must follow to remove the cartridge.

Note: These procedure must be performed only by a trained IBM service provider. SSRs should claim their time against service code 33 ECA 013 when performing this procedure.

Note: If the cartridge in the drive is an INPUT tape containing ACTIVE or 'ONLY COPY' data (i.e., there is no backup), and both eject commands issued at the host and power-cycling the drive fail to eject the cartridge, make no further attempts to unload this tape. Call Technical Support and open a PMR if one isn't already open to initiate the process of sending the drive with the loaded cartridge in for recovery.

- Before using this procedure, you must have exhausted all other means of removing the tape cartridge from the drive. Use this procedure **only** if you cannot remove the tape cartridge by using any other means.

- Determine from the customer if the cartridge contains **critical customer data**. If the cartridge contains sensitive data that cannot leave the site, inform the customer that certain failure conditions diagnostics will be performed to test the drive for continued use.
- The following removal procedures **can destroy** customer data! Use **extreme care** when handling or removing the customer's tape cartridges to minimize tape damage and lost data.
- **DO NOT TOUCH** the magnetic tape or tape path. Both are extremely sensitive to the oil and salt from your skin. Use clean, lint-free gloves when working around magnetic tape or the tape path components.
- Electrostatic-sensitive components: Consider using an ESD Kit.
- After you remove the tape cartridge, advise the customer to copy the data to another cartridge and to remove this tape cartridge from service.
- Do not use power tools or magnetic tools to perform this procedure.
- To avoid contamination and electrostatic-discharge damage to the drive, never touch the head or electronic components inside the drive.
- If you cannot remove the cartridge from the drive using the following procedures, contact your next level of support.

Before You Begin

1. If you have not already done so, attempt to remove the cartridge with the device power ON and using library manager, a host application, or the Unload Button.
2. If you have not already done so, attempt to remove the cartridge by power cycling the drive. Look for the drive to attempt a mid-tape recovery.

   Note: It can take as long as five minutes for the cartridge to rewind and unload.
3. If the cartridge unloads, inform the operator that the cartridge is unloaded. If the cartridge does not unload, continue with this procedure.

Recommended Tools

- 2.5 mm offset hex wrench (do not use magnetized wrench)
- #1 Phillips screwdriver
- ESD Kit
- Flashlight (optional)
- #1 Flathead screwdriver (optional)

Beginning Procedure

1. Remove the drive from the enclosure (see “Removing a Drive Sled” on page 7-42.
2. Place the drive on a nonslip, sturdy work surface.
3. Remove the drive from the sled (see “Removing a Drive from a Sled” on page 7-134).
4. Ground yourself to the drive by using an ESD Kit.
5. Remove the cover of the drive by performing the following steps:
   a. Using a Phillips screwdriver, remove the three screws and washers (see **1** in Figure 7-148 on page 7-134) that secure the bezel (see **2**) to the internal drive, then remove the bezel.

b. Remove the cover of the internal drive by performing the following steps:
   1) Remove the four cover-mounting screws and washers (see **3**).
   2) Remove the cover by lifting it up.

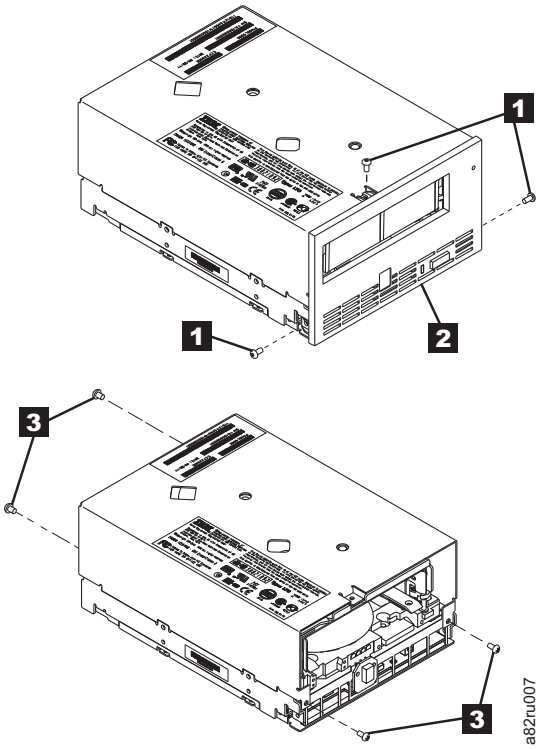

Figure 7-148. Removing the cover from the internal drive

6. Inspect the drive to decide which of the following conditions most closely matches the symptom on the drive:
   - **Tape spooled off the supply reel** - All the tape appears to be on the take up reel and no tape is on the supply reel (inside the cartridge). Test the drive after the procedure is completed.
   - **Tape pulled from leader pin (or broken at the front end)** - All the tape appears to be on the supply reel (inside the cartridge) and very little or no tape appears to be on the take up reel. The leader block is positioned in the take up reel. Return the drive after the procedure is completed.
   - **Tape broken in mid-tape** - Tape appears to be on both the supply reel (inside the cartridge) and take up reel. Test the drive after the procedure is completed.
   - **Tape tangled along tape path** - Tape appears to be tangled and damaged but in tact. Return the drive after the procedure is completed.

     -- OR --

     No damage to tape (or no apparent failure) - There appears to be no damage or slack to the tape. Return the drive after the procedure is completed.

Removing a Drive from a Sled

1. Place the sled so the base is up (the orange notice is visible).
2. Remove the four screws (read the notice for screw replacement).
3. Turn the sled over and remove the six (T-10) cover screws.

4. Remove the cover.
5. Remove the two screws from the barcode bracket (make note of the barcode orientation for replacement).
6. Slide the drive forward approximately two inches.
7. Remove the power and interface connectors from the drive.
8. Remove the RS422 connector from the sled board (keyed).
9. Lift or slide the drive out of the sled housing.

Tape Spooled off Supply Reel

1. With the front of the drive facing you, pull an arm's length of tape out of the take up reel from the left side of the drive.
2. From the take up reel, thread tape around the rear of the tape path and over the head rollers on the left side of the drive.
3. Set the drive on its left side with the head and tape path facing up.
4. Moisten a cotton swab with water and wet approximately 13 mm (0.5 in.) of the tape end and feed it onto the supply reel (inside the cartridge).
5. From the bottom of the drive, insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle.

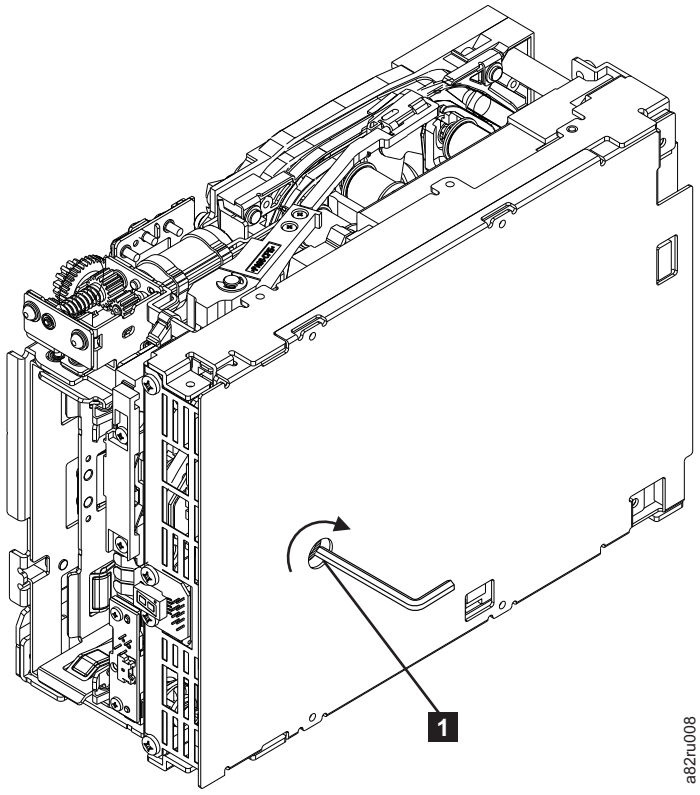

Figure 7-149. Using hex wrench to rewind tape into cartridge

6. Turn the supply reel clockwise, allowing the moistened tape to adhere to the hub as it winds around the supply reel (inside the cartridge).
7. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
8. Reassemble the drive, reversing the steps in “Beginning Procedure” on page 7-133.

9. Allow the drive to perform mid-tape recovery. This takes several minutes. When this activity completes, the cartridge ejects automatically.
10. Test the drive to determine if it should be replaced.

Tape Pulled from or Broken near Leader Pin

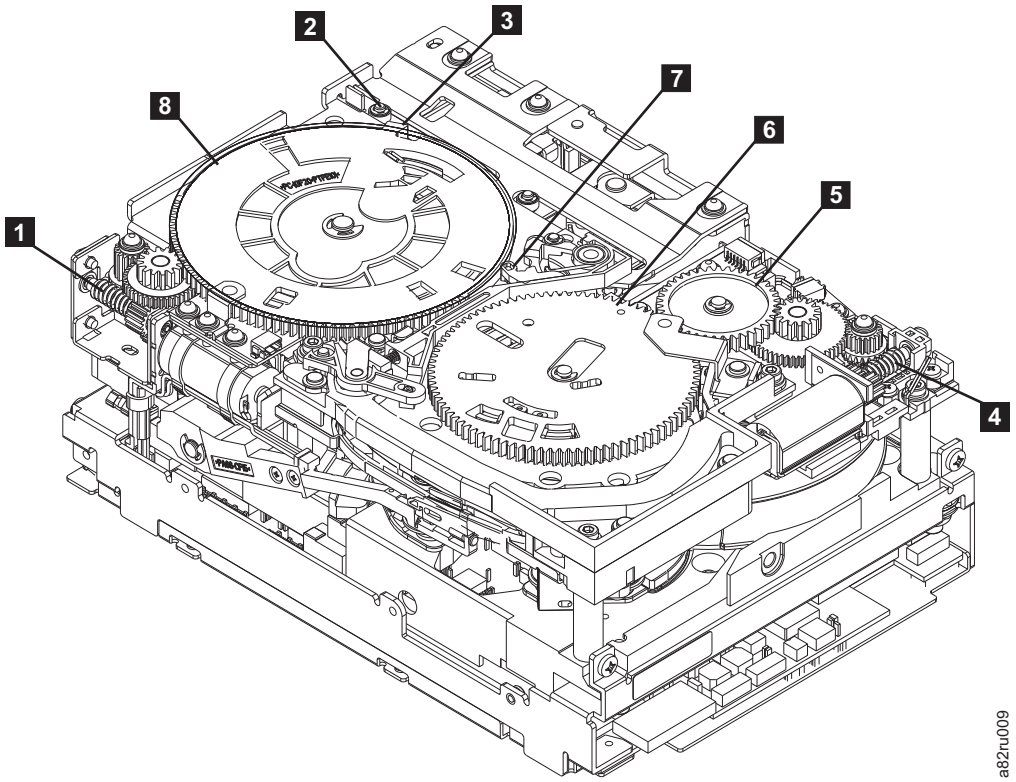

Figure 7-150. Drive with cover removed to reveal gear train

1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever
3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear	9	Threader worm gear
5	Threader intermediate gear		

1. From the left side of the drive, pull out tape from the take up reel.

   Note: If there is more than approximately 0.6 m (2 ft.) of tape on the take up reel, go to "Tape Broken in Mid-tape" on page 7-138.
2. If there is less than approximately 0.6 m (2 ft.) of tape on the take up reel, cut off the excess tape as close to the leader pin, as possible.
3. Locate the threader motor worm gear (4 in Figure 7-150) the rear of the drive. You can either:
   a. Use your finger to rotate the threader motor worm gear and slowly rotate the threader mechanism gear (6 in Figure 7-150) clockwise; or
   b. Use a #1 flathead screwdriver to turn the threader worm gear (9 in Figure 7-150) clockwise.

This rotates the threader motor worm gear (6 in Figure 7-150 on page 7-136) clockwise, drawing the tape leader block assembly (LBA) into the cartridge.

4. As the LBA is secured in the cartridge, you should hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (4 in Figure 7-150 on page 7-136) stops. The LBA is in the correct position.

   Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench (1) in Figure 7-151.

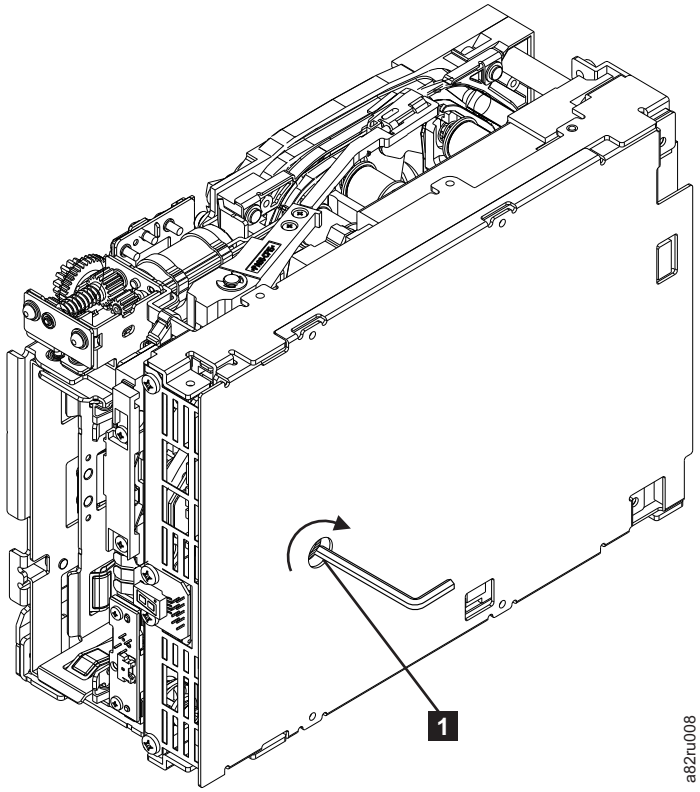

Figure 7-151. Using hex wrench to rewind tape into cartridge

5. Notice the following:
   a. Loader mechanism gear (8 in Figure 7-150 on page 7-136) nearest the front of the drive that actuates the cartridge loader mechanism
   b. Position of the rotator stub (3 in Figure 7-150 on page 7-136).
   c. Front loader motor worm gear (8 in Figure 7-150 on page 7-136). Rotating this gear allows the loader mechanism gear (1 in Figure 7-150 on page 7-136) to turn.
6. Rotate the loader motor worm gear (1 in Figure 7-150 on page 7-136) to turn the loader mechanism gear (6 in Figure 7-150 on page 7-136) counterclockwise. Continue turning until the rotator stub (3 in Figure 7-150 on page 7-136) loses contact with the lever (7 in Figure 7-150 on page 7-136). This releases the LBA leader pin.
7. Rotate the threader motor worm gear (4 in Figure 7-150 on page 7-136) to turn the threader mechanism gear (6 in Figure 7-150 on page 7-136) counterclockwise. This moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller

nearest the rear of the drive (1 in Figure 7-152).

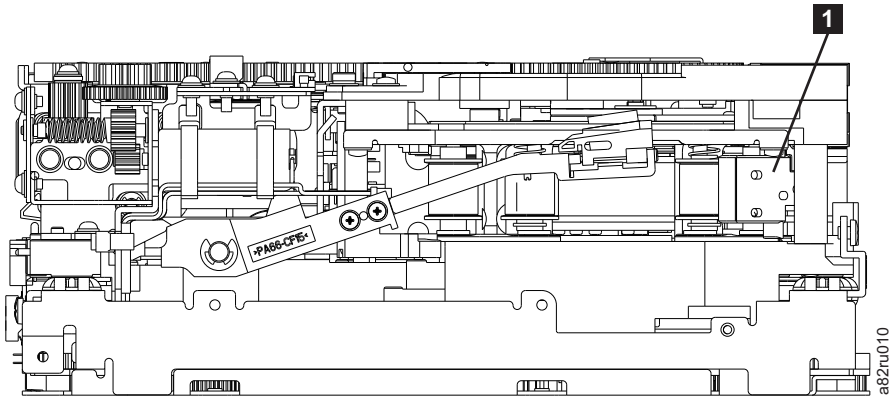

Figure 7-152. Leader Block Assembly (LBA)

8. Continue rotating the loader motor worm gear (1 in Figure 7-150 on page 7-136) until the rotate stub (3 in Figure 7-150 on page 7-136) is positioned as shown. Notice that the rotator stub (3 in Figure 7-150 on page 7-136) is nearly aligned with the cartridge loader tray guide bearing (2 in Figure 7-150 on page 7-136).
9. Remove the cartridge from the cartridge loader tray.
10. Reassemble the drive by reversing the procedure in Step 5 in "Beginning Procedure" on page 7-133.
11. Refer to the appropriate procedure to install the new drive and return the failed drive.

Tape Broken in Mid-tape

1. With the front of the drive facing you, pull an arm's length of tape out of the take up reel from the left side of the drive.

   Note: If there is less than approximately 5 cm (2 in.) of tape on the take up reel, go to "Tape Pulled from or Broken near Leader Pin" on page 7-136.
2. From the supply reel inside the cartridge, pull approximately 0.3 m (1 ft.) of tape.
3. From the take up reel, thread tape around the rear of the tape path and over the head rollers on the left side of the drive.
4. Moisten a cotton swab with water, and wet approximately 13 mm (0.5 in.) of the tape end. Overlap the tape ends, loosely mending them together.
5. Set the drive on its left side with the head and tape path facing up.
6. From the bottom of the drive, locate the access hole (1 in Figure 7-153 on page 7-139) in the bottom cover. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. begin spooling tape back into the cartridge by turning the hex wrench clockwise.

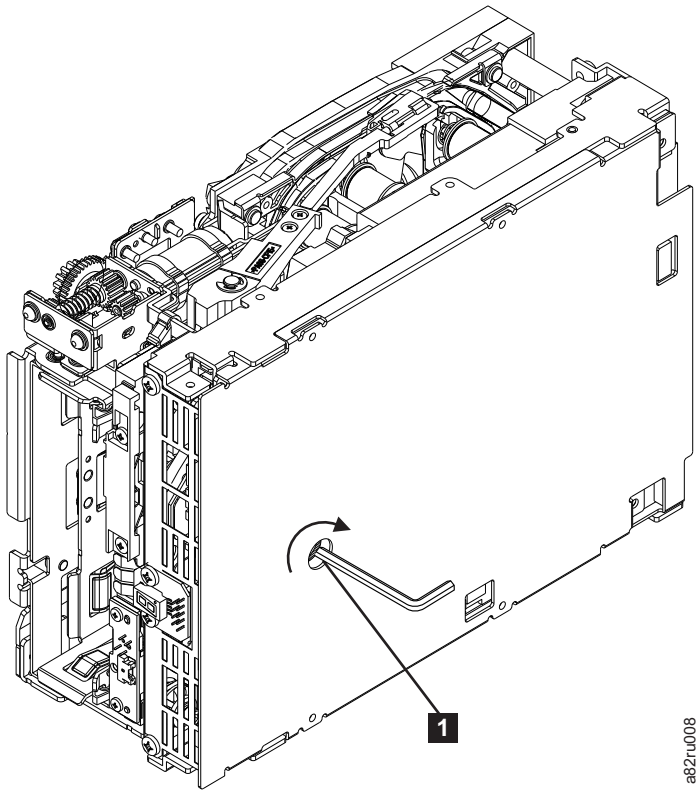

Figure 7-153. Using hex wrench to rewind tape into cartridge

7. Turn the supply reel clockwise, carefully guiding the mended portion of the tape to wind around the hub of the supply reel located inside the cartridge. Continue spooling into the cartridge until the tape is taut. The tape must remain within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
8. Reassemble the drive by reversing the procedure in Step 5 in "Beginning Procedure" on page 7-133.
9. Allow the drive to perform mid-tape recovery. This takes several minutes. When this activity completes, the cartridge ejects automatically.
10. Test the drive to determine if it should be replaced.

Tape Tangled along Tape Path

1. Carefully pull out excess tape and untangle.

   Note: If you find the tape to be broken, go to one of the following appropriate procedures:
   - "Tape Spooled off Supply Reel" on page 7-135
   - "Tape Pulled from or Broken near Leader Pin" on page 7-136

   --OR--

   "Tape Broken in Mid-tape" on page 7-138
2. Set the drive on its left side with the head and tape path facing up.

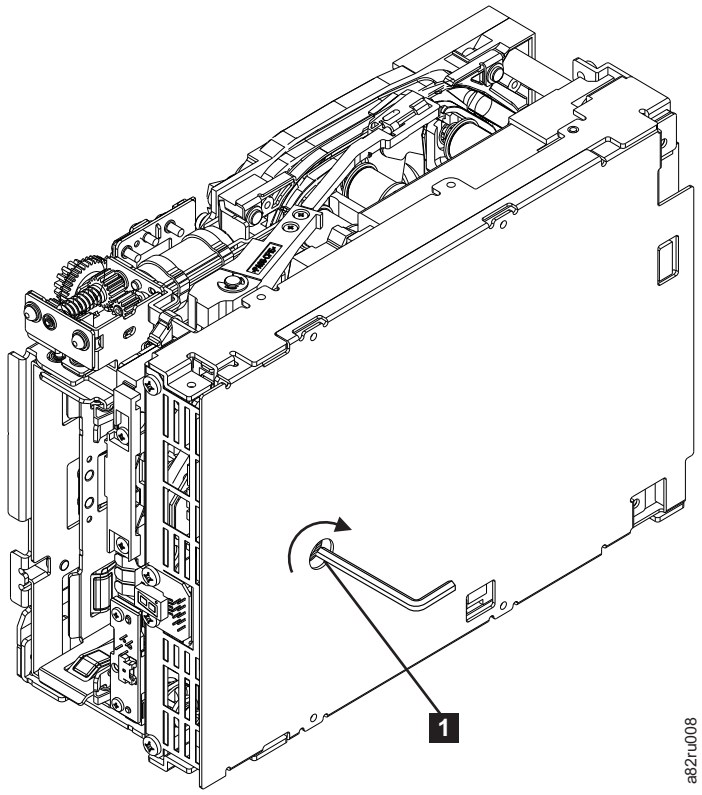

Figure 7-154. Using hex wrench to rewind tape into cartridge

3. From the bottom of the drive, locate the access hole (**1** in Figure 7-154).
4. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. Begin spooling the tape back into the cartridge by turning the hex wrench clockwise.
5. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
6. Locate the threader motor worm gear (**4** in Figure 7-155 on page 7-141) on the rear of the drive. You can either:
   a. Use your finger to rotate the treader motor worm gear and slowly rotate the threader mechanism gear (**6** in Figure 7-155 on page 7-141) clockwise; OR
   b. Use a #1 flathead screwdriver to turn the worm gear (**9** in Figure 7-155 on page 7-141) clockwise.

   This rotates the threader motor worm gear (**4** in Figure 7-155 on page 7-141) clockwise, drawing the LBA into the cartridge.

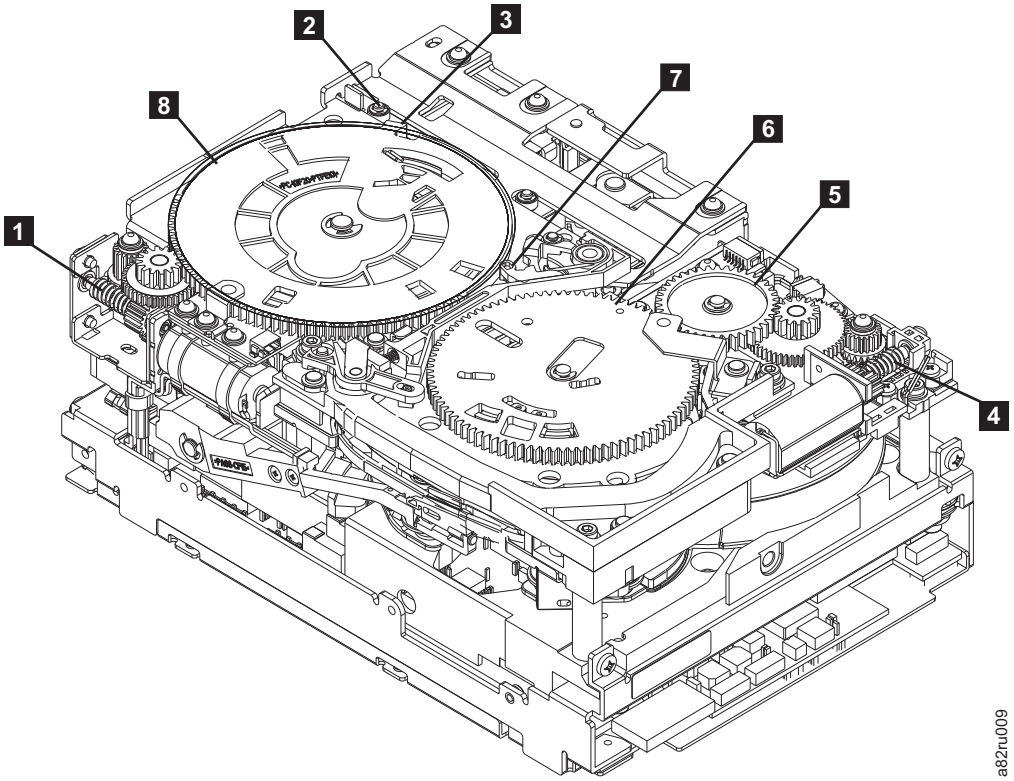

Figure 7-155. Drive with cover removed to reveal gear train.

1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever
3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear	9	Threader worm gear
5	Threader intermediate gear		

7. As the tape leader block assembly (LBA) is secured in the cartridge, you should hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (4 in Figure 7-155) stops. The LBA is in the correct position.

   Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench as shown in Figure 7-154 on page 7-140.

8. Notice the:
   a. Loader mechanism gear (6 in Figure 7-155) nearest the front of the drive that actuates the cartridge loader mechanism.
   b. Position of the rotate stub (3 in Figure 7-155).
   c. Front loader motor worm gear (1 in Figure 7-155). Rotating this gear allows the loader mechanism gear (8 in Figure 7-155) to turn.
9. Rotate the loader motor worm gear (1 in Figure 7-155) to turn the threader mechanism gear (6 in Figure 7-155) counterclockwise. Continue turning until the rotator stub (3 in Figure 7-155) loses contact with the lever (7 in Figure 7-155). This releases the LBA leader pin.

10. Rotate the threader motor worm gear (**4** in Figure 7-155 on page 7-141) to turn the threader mechanism gear (**6** in Figure 7-155 on page 7-141) counterclockwise. This moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller nearest the rear of the drive shown as **1** Figure 7-156.

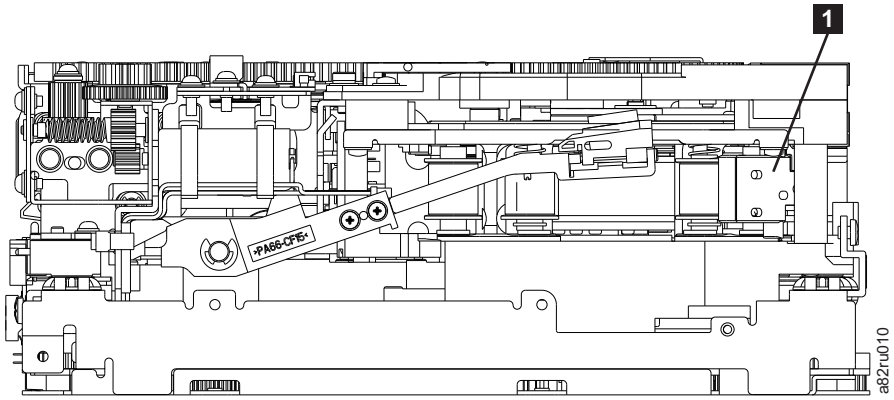

Figure 7-156. Leader Block Assembly (LBA)

11. Continue rotating the loader motor worm gear (**1** in Figure 7-155 on page 7-141) until the rotator stub (**3** in Figure 7-155 on page 7-141) is positioned as shown. Notice that the rotator stub (**3** in Figure 7-155 on page 7-141) is nearly aligned with the cartridge loader tray guide bearing (**2** in Figure 7-155 on page 7-141).
12. Remove the cartridge from the cartridge loader tray.
13. Reassemble the drive by reversing the procedure in Step 5 in "Beginning Procedure" on page 7-133.
14. Refer to the appropriate procedure to install the new drive and return the failed drive.

No Apparent Failure or Damage to Tape

1. Set the drive on its left side with the head and tape path facing up.

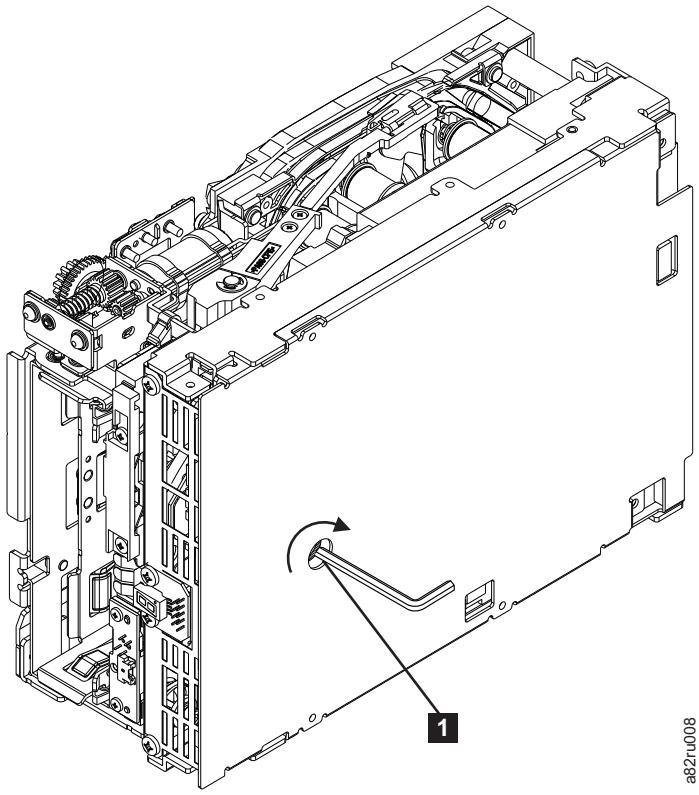

Figure 7-157. Using hex wrench to rewind tape into cartridge

2. From the bottom of the drive, locate the access hole (**1** in Figure 7-157).
3. Insert a 2.5 mm offset hex wrench through the bottom cover access hole and into the reel motor axle. Begin spooling the tape back into the cartridge by turning the hex wrench clockwise.
4. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape.
5. Locate the threader motor worm gear (**4** in Figure 7-158 on page 7-144) on the rear of the drive. You can either:
   a. Use your finger to rotate the threader motor worm gear and slowly rotate the threader mechanism gear (**6** in Figure 7-158 on page 7-144) clockwise;

      --OR--

   b. Use a #1 flathead screwdriver to turn the threader worm gear (**9** in Figure 7-158 on page 7-144) clockwise.

   This rotates the threader motor worm gear (**4** in Figure 7-158 on page 7-144) clockwise, drawing the LBA into the cartridge.

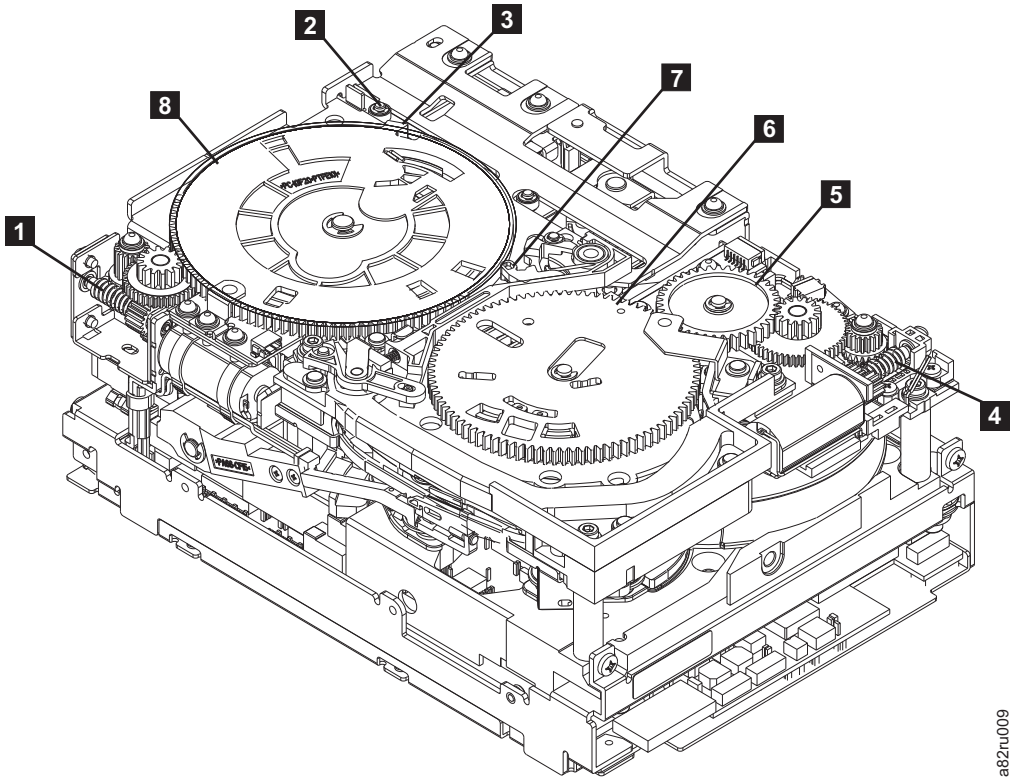

Figure 7-158. Drive with cover removed to reveal gear train.

1	Loader motor worm gear	6	Threader mechanism gear
2	Cartridge loader tray guide bearing	7	Lever
3	Rotator stub	8	Loader mechanism gear
4	Threader motor worm gear	9	Threader worm gear
5	Threader intermediate gear		

6. As the tape leader block assembly (LBA) is secured in the cartridge, you should hear the LBA retention spring clips click into place. If you do not hear the click, continue rolling until the threader motor worm gear (4 in Figure 7-158) stops. The LBA is in the correct position.

   Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge by using a hex wrench as shown in Figure 7-157 on page 7-143.

7. Notice the:
   a. Loader mechanism gear (6 in Figure 7-158) nearest the front of the drive that actuates the cartridge loader mechanism.
   b. Position of the rotate stub (3 in Figure 7-158).
   c. Front loader motor worm gear (1 in Figure 7-158). Rotating this gear allows the loader mechanism gear (8 in Figure 7-158) to turn.
8. Rotate the loader motor worm gear (1 in Figure 7-158) to turn the threader mechanism gear (6 in Figure 7-158) counterclockwise. Continue turning until the rotator stub (3 in Figure 7-158) loses contact with the lever (7 in Figure 7-158). This releases the LBA leader pin.

9. Rotate the threader motor worm gear (**4** in Figure 7-158 on page 7-144) to turn the threader mechanism gear (**6** in Figure 7-158 on page 7-144) counterclockwise. This moves the LBA out of the cartridge and past the read/write head. Stop this rotation when the LBA is near the tape guide roller nearest the rear of the drive shown as **1** Figure 7-159.

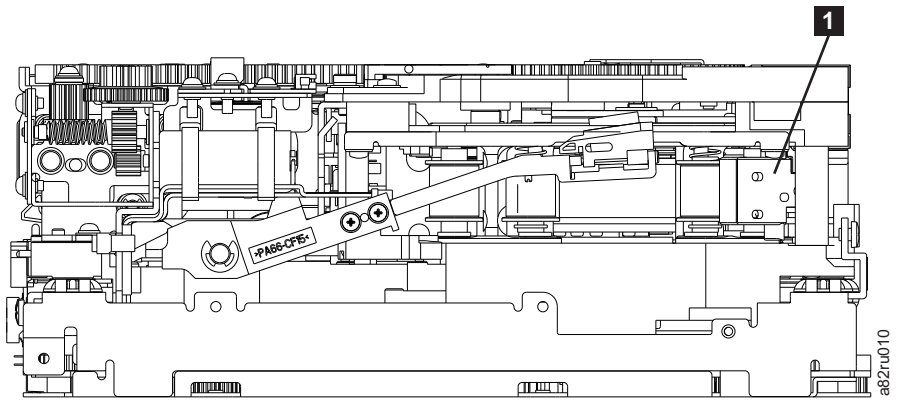

Figure 7-159. Leader Block Assembly (LBA)

10. Continue rotating the loader motor worm gear (**1** in Figure 7-158 on page 7-144) until the rotator stub (**3** in Figure 7-158 on page 7-144) is positioned as shown. Notice that the rotator stub (**3** in Figure 7-158 on page 7-144) is nearly aligned with the cartridge loader tray guide bearing (**2** in Figure 7-158 on page 7-144).
11. Remove the cartridge from the cartridge loader tray.
12. Reassemble the drive by reversing the procedure in Step 5 in "Beginning Procedure" on page 7-133.
13. Refer to the appropriate procedure to install the new drive and return the failed drive.

Chapter 8. History of Service Activity

Table 8-1. Service activity

Date	Service Representative	Parts Exchanged	Description of Service Activity

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Table 8-1. Service activity (continued)

Date	Service Representative	Parts Exchanged	Description of Service Activity

Table 8-1. Service activity (continued)

Date	Service Representative	Parts Exchanged	Description of Service Activity

Chapter 9. Parts List

Field Replaceable Unit (FRU) parts list

FRU Type	Description	FRU Part Number
Assemblies	Display (Operator Panel)	23R6174
	I/O Station for control module	23R2587
	I/O Station for 9U expansion module	23R2588
	Expansion module enclosure	23R6168
	I/O Station Lock Assembly	23R2589
	Y-axis Assembly (Below Control Module S/N 15000)	23R6186
	Y Motor (Below Control Module S/N 15000)	23R7285
	Picker with Bar Code Scanner (Below Control Module S/N 15000)	23R6171
	Cable Spool	23R2583
	M2 Robot Assembly (Above Control Module S/N 15000)	45E6348
	M2 Picker Assembly (Above Control Module S/N 15000)	45E6351
	Power Button	23R3348
	Front Bezels for control module	23R2597
	Front Bezels for 9U expansion module	23R2598
Miscellaneous	5U drive power overload fuse	23R6178
	9U drive power overload fuse	23R6185
	Storage magazine (8 slot with fiducial)	23R7286
	Storage magazine (16 slot with fiducial)	23R7287
	I/O Station magazine	23R3640
	Gear Racks (front and back) for L5B control module	23R9476
	Gear Racks for E9U expansion module	23R9477
Kits	CAN Bus Tool Kit	46X1438
	Kit 1, Door Interlock Switch	23R6179
	Kit 2, Power Switch/LED Board and Cable	23R6180
	Kit 3, Internal Cables and Boards, 5U Control Module	23R6181
	Kit, Misc. parts ('Y' home flag, door Inlk., cover screws)	95P4564
	Kit, I/O Safety Flap, 5U Control Module	95P5424
	Kit, I/O Safety Flap, 9U Expansion Module	95P5425

Customer Replaceable Unit (CRU) parts list

Important: This library has Tier 1 CRUs (customer replaceable units). These CRUs are parts of the library that must be added, removed, and replaced by the customer. If a customer chooses to have the CRU added or removed/replaced by an IBM Service Representative, there will be a charge for the service.

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Before ordering a replacement CRU, ensure that the following criteria is met:

- The failure is repeatable.
- A dump is captured for emailing to IBM Service.
  - Use the Web User Interface (**Service Library** > **Capture Library Log**) for library dumps.
  - Use the Web User Interface (**Service Library** > **Capture Drive Log**) for drive dumps.

CRU Type	Description	Feature Code	CRU Part Number
Assemblies	LTO Ultrium Gen 3 LVD Ultra160 drive sled	8037	23R6182
	LTO Ultrium Gen 3 2 Gb Fibre drive sled	—	23R2601
	LTO Ultrium Gen 3 4 Gb Fibre drive sled	8042	23R6450
	LTO Ultrium Gen 4 Fibre drive sled	8142	95P4824
	LTO Ultrium Gen 4 SAS drive sled	8139	95P4825
	LTO Ultrium Gen 5 Fibre drive sled	8242	46X4440
	Power Supply	1900	23R2582
	Library Control Blade (LCB) without Compact Flash (CF) Card	—	23R6165
	Compact Flash Card	—	45E3170
	Rack Mount Kit	7003	—
License Keys	Capacity Expansion	1640	—
	Advanced Reporting	1650	—
	Path Failover	1682	—
	Transparent LTO Encryption	5900	—
Terminators & Wrap Plugs	Terminator, LVD multi-mode	—	23R5841
	Terminator, Module Communication	—	45E8321
	LVD SCSI Wrap Tool	—	23R5840
	Fibre Wrap Tool	—	12R9314
Interposers	Interposer, LC-SC fibre cable	5096	12R9321
	Interposer, VHDCI/HD68 SCSI cable	—	12R9321
	Interposer, SAS/MiniSAS 4x (2.0m max. cable length)	5400	95P4994
	Interposer, MiniSAS/MiniSAS 4x (2.0m max. cable length)	5500	95P4996

CRU Type	Description	Feature Code	CRU Part Number
Miscellaneous	Cable, Module-to-Module Communication	—	23R2602
	Cable, RJ45 Ethernet Crossover	—	23R3663
	Cover, top for control module and expansion module	—	23R2594
	Cover, side for 5U control module	—	23R2595
	Covers, side for 9U expansion module	—	23R2596
	Cover plate for empty slot next to LCB	—	23R2604
	Cover plate for empty Power Supply slot	—	23R2606
	Cover plate for empty drive slot	—	23R2605
	Library and Drive Firmware Update (by an IBM Service Representative)	0500	—
	Rack ears kit	—	23R3349
	Rack Power Distribution Unit (PDU) power cord	9848	39M5378
	Foot pads kit	—	23R2599
SCSI Cables, HD68/HD68	0.4 m	8037	23R6408
SCSI Cables, VHDCI/HD68	2.5 m	5602	23R3841
	4.5 m	5604	23R3594
	10 m	5610	23R3593
Fibre Cables, LC-LC	5 m	6005	39M5700
	13 m	6013	39M5701
	25 m	6025	12R9915
SAS Cables, SAS to MiniSAS 1x	2 m	5402	95P4587
	5.5 m (Do not use with 4x interposer, FC 5400)	5406	95P4588
SAS Cables, Mini SAS to MiniSAS 1x	2 m	5502	95P4488
	5.5 m (Do not use with 4x interposer, FC 5500)	5506	95P4494

Power Cords and Receptacles

Figure 9-1 on page 9-4 shows the plugs that are used by the power cords in Table 9-1 on page 9-4. Match the index number that is beside each plug to the index number in the table.

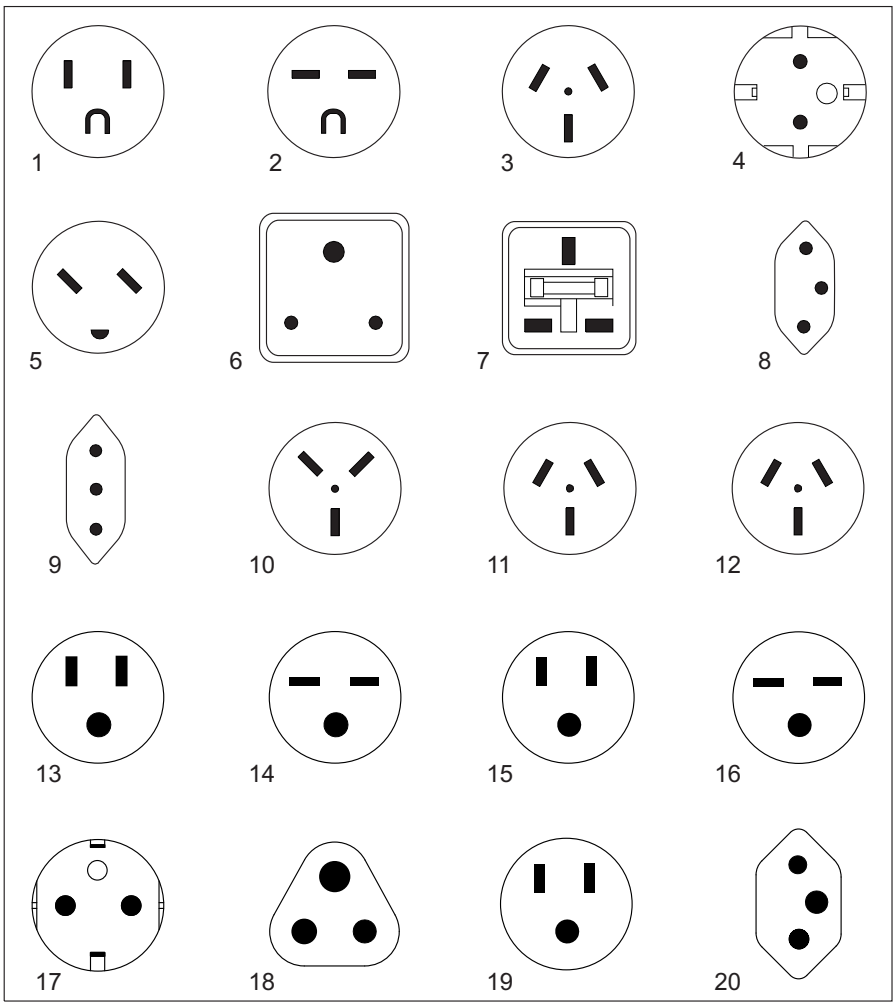

Figure 9-1. Types of Power Cord Receptacles

Table 9-1. Power Cords

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure 9-1
US/Canada • 2.8 m, 125V • FC 9800 • PN 39M5081 • (See Note)	NEMA 5-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, South Korea, Suriname, Taiwan, Trinidad Tobago, Venezuela, US	1

Table 9-1. Power Cords (continued)

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure 9-1 on page 9-4
Chicago • 1.8 m, 125 V • FC 9986 • PN 39M5080	NEMA 5-15P	Chicago, U.S.A.	1
US/Canada • 2.8 m, 250 V • FC 9833 • PN 39M5095	NEMA 6-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Suriname, Taiwan, Thailand, Trinidad Tobago, Venezuela, US	2
Australia • 2.8 m, 250V • FC 9831 • PN 39M5102	AS 3112 NZS 198	Argentina, Australia, China, Colombia, New Zealand, Papua New Guinea, Paraguay, Uruguay, Western Samoa	3
France, Germany • 2.8 m, 250V • FC 9820 • PN 39M5123	CEE 7 - VII	Afghanistan, Algeria, Andorra, Angola, Aruba, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo-Brazzaville, Curacao, Czech Republic, Democractic Republic of Congo, Denmark, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Kenya, Korea, Lebanon, Luxembourg, Macau, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, Netherlands Antilles, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Spain, Sweden, Sudan, Syria, Togo, Tunisia, Turkey, Yugoslavia, Zaire, Zimbabwe, Vietnam	4

Table 9-1. Power Cords (continued)

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure 9-1 on page 9-4
Denmark • 2.8 m, 250V • FC 9821 • PN 39M5130	DK2-5A	Denmark	5
South Africa • 2.8 m, 250V • FC 9829 • PN 39M5144	SABS 164	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka	6
United Kingdom • 2.8 m, 250V • FC 9825 • PN 39M5151	BS 1363	Antigua, Bahrain, Bermuda, Brunei, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Fiji, Ghana, Guyana, India, Iraq, Ireland, Jordan, Kenya, Kuwait, Malaysia, Malawi, Malta, Nepal, Nigeria, Oman, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, UK, United Arab Emirate (Dubai), Yemen, Zambia	7
Switzerland • 2.8 m, 250V • FC 9828 • PN 39M5158	SEV SN 416534	Liechtenstein, Switzerland	8
Italy • 2.8 m, 250V • FC 9830 • PN 39M5165	CEI 23- 16	Chile, Ethiopia, Italy, Libya, Somalia	9
Israel • 2.8 m, 250V • FC 9827 • PN 39M5172	S11-32-1971	Israel	10
Argentina • 2.8 m, 250V • FC 9834 • PN 39M5068	IEC 83-A5	Argentina, Brazil, Colombia, Paraguay, Trinidad Tobago, Uruguay	11
China • 2.8 m, 250V • FC 9840 • PN 39M5206	CCEE	People's Republic of China	12
Taiwan LV* • 2.8 m, 125V • FC 9835 • PN 39M5247	CNS 10917-3	Taiwan	13

Table 9-1. Power Cords (continued)

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure 9-1 on page 9-4
Taiwan HV** • 2.8 m, 250V • FC 9841 • PN 39M5254	CNS 10917-3	Taiwan	14
Japan LV* • 2.8 m, 125V • FC 9842 • PN 39M5199	JIS C8303, C8306	Japan	15
Japan HV** • 2.8 m, 250V • FC 9843 • PN 39M5186	JIS C8303, C8306	Japan	16
Korea HV** • 2.8 m, 250V • FC 9844 • PN 39M5219	KS C8305, K60884-1	Korea	17
India HV** • 2.8 m, 250V • FC 9845 • PN 39M5226	IS 6538	India	18
Brazil LV* • 2.8 m, 125V • FC 9846 • PN 39M5233	InMetro NBR 6147	Brazil	19
Brazil HV** • 2.8 m, 250V • FC 9847 • PN 39M5240	InMetro NBR 14136	Brazil	20
* Low Voltage ** High Voltage			

Appendix A. TapeAlert Flags Supported by the Drive

This appendix is intended to provide additional information to the reader about the tape drive. All error code and diagnostic information contained in this chapter can be accessed from the Operator Panel of the Library. The drive portion of the Operator Panel Display will contain any drive error codes. Therefore there is no need to open the Library to access the buttons on the drive as described in this chapter. See the Setup and Operator Guide for a complete description of the Operator Panel functions and Displays.

TapeAlert is a standard that defines status conditions and problems experienced by devices such as tape drives, autoloaders, and libraries. The standard enables a server to read TapeAlert messages (called *flags*) from a tape drive via the SCSI bus. The server reads the flags from Log Sense Page 0x2E.

This library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the server. Because library and drive firmware may change periodically, the SNMP interface in the library does not require code changes if devices add additional TapeAlerts that are not supported today. However, should this occur the MIB is written to minimize impact to the SNMP monitoring station. At the time of this writing, the TapeAlert flags in this appendix correctly represent TapeAlerts that will be sent. The MIB file should not be taken to mean that all traps that are defined in the MIB will be sent by the library or that they will be sent in the future.

This appendix lists TapeAlert flags that are supported by the Ultrium Tape Drives.

Table A-1. TapeAlert Flags Supported by the Ultrium Tape Drive

Flag Number	Flag	SNMP Trap	Description	Action Required
3	Hard error	No	Set for any unrecoverable read, write, or positioning error. (This flag is set in conjunction with flags 4, 5, or 6.)	See the Action Required column for Flag Number 4, 5, or 6 in this table.
4	Media	No	Set for any unrecoverable read, write, or positioning error that is due to a faulty tape cartridge.	Replace the tape cartridge.
5	Read failure	No	Set for any unrecoverable read error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in "Drive Error Codes" on page D-42.

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Table A-1. TapeAlert Flags Supported by the Ultrium Tape Drive (continued)

Flag Number	Flag	SNMP Trap	Description	Action Required
6	Write failure	No	Set for any unrecoverable write or positioning error where isolation is uncertain and failure could be due to a faulty tape cartridge or to faulty drive hardware.	If Flag Number 9 is also set, make sure that the write-protect switch is set so that data can be written to the tape (see "Write-Protect Switch" on page D-7). If Flag Number 4 is also set, the cartridge is defective. Replace the tape cartridge. If Flag Number 4 is not set, see Error Code 6 in "Drive Error Codes" on page D-42.
7	Media life	No	Set when the tape cartridge reaches its end of life (EOL).	1. Copy the data to another tape cartridge. 2. Discard the old (EOL) cartridge.
8	Not data grade	No	Set when the cartridge is not data-grade. Any data that you write to the tape is at risk.	Replace the tape with a data-grade tape.
9	Write protect	No	Set when the tape drive detects that the tape cartridge is write-protected.	Ensure that the cartridge's write-protect switch is set so that the tape drive can write data to the tape (see "Write-Protect Switch" on page D-7).
10	No removal	No	Set when the tape drive receives an UNLOAD command after the server prevented the tape cartridge from being removed.	Refer to the documentation for your server's operating system.
11	Cleaning media	No	Set when you load a cleaning cartridge into the drive.	No action required.
12	Unsupported format	No	Set when you load an unsupported cartridge type into the drive or when the cartridge format has been corrupted.	Use a supported tape cartridge.
14	Unrecoverable snapped tape	No	Set when the operation failed because the tape in the drive snapped.	See "Manual Cartridge Removal from a Drive" on page 7-132.
15	Cartridge memory chip failure	No	Set when a cartridge memory (CM) failure is detected on the loaded tape cartridge.	Replace the tape cartridge. If this message occurs on multiple cartridges, see Error Code 6 in "Drive Error Codes" on page D-42.
16	Forced eject	No	Set when you manually unload the tape cartridge while the drive was reading or writing.	No action required.
17	Media loaded is Read-only format	No	Set when a cartridge marked as read-only is loaded into the drive. The flag is cleared when the cartridge is ejected.	No action required.

Table A-1. TapeAlert Flags Supported by the Ultrium Tape Drive (continued)

Flag Number	Flag	SNMP Trap	Description	Action Required
18	Tape directory corrupted in the cartridge memory	No	Set when the drive detects that the tape directory in the cartridge memory has been corrupted.	Re-read all data from the tape to rebuild the tape directory.
19	Nearing media life	No	Set when the tape cartridge is nearing its specified end of life. The flag is cleared when the cartridge is removed from the drive.	1. Copy the data to another tape cartridge. 2. Replace the tape cartridge.
20	Clean now	No	Set when the tape drive detects that it needs cleaning.	Clean the tape drive.
21	Clean periodic	No	Set when the drive detects that it needs routine cleaning.	Clean the tape drive as soon as possible. The drive can continue to operate, but you should clean the drive soon.
22	Expired clean	No	Set when the tape drive detects a cleaning cartridge that has expired.	Replace the cleaning cartridge.
23	Invalid cleaning tape	No	Set when the drive expects a cleaning cartridge and the loaded cartridge is not a cleaning cartridge.	Use a valid cleaning cartridge.
30	Hardware A	No	Set when a hardware failure occurs that requires that you reset the tape drive to recover.	See “Resetting a Drive” on page 6-40. If resetting the drive does not recover the error, note the error code on the single-character display, then see “Drive Error Codes” on page D-42.
31	Hardware B	No	Set when the tape drive fails its internal Power-On Self Tests.	Note the error code on the single-character display, then see “Drive Error Codes” on page D-42.
32	Interface	No	Set when the tape drive detects a problem with the host interface.	See Error Code 8 or 9 in“Drive Error Codes” on page D-42
33	Eject media	No	Set when a failure occurs that requires you to unload the cartridge from the drive.	Unload the tape cartridge, then reinsert it and restart the operation.
34	Download fail	No	Set when an FMR image is unsuccessfully downloaded to the tape drive through the host interface.	Ensure that it is the correct FMR image. Download the FMR image again.
36	Drive temperature	No	Set when the drive's temperature sensor indicates that the drive's temperature is exceeding the recommended temperature of the library.	See Error Code 1 in “Drive Error Codes” on page D-42.

Table A-1. TapeAlert Flags Supported by the Ultrium Tape Drive (continued)

Flag Number	Flag	SNMP Trap	Description	Action Required
37	Drive voltage	No	Set when the drive detects that the externally supplied voltages are either approaching the specified voltage limits or are outside the voltage limits.	See Error Code 2 in "Drive Error Codes" on page D-42.
38	Predictive failure of drive hardware	No	Set when a hardware failure of the tape drive is predicted.	
39	Diagnostics required	No	Set when the drive detects a failure that requires diagnostics for isolation.	See "Diagnostic and Maintenance Functions" on page D-26.
51	Tape directory invalid at unload	No	Set when the tape directory on the tape cartridge that was previously unloaded is corrupted. The file-search performance is degraded.	Use your backup software to rebuild the tape directory by reading all the data.
52	Tape system area write failure	No	Set when the tape cartridge that was previously unloaded could not write its system area successfully.	Copy the data to another tape cartridge, then discard the old cartridge.
53	Tape system area read failure	No	Set when the tape system area could not be read successfully at load time.	Copy the data to another tape cartridge, then discard the old cartridge.
55	Loading Failure	No	When loading a tape into a drive, a hardware malfunction can prevent the tape from being loaded into the drive, or the tape may actually get stuck in the drive.	Possible Causes: 1. A drive hardware error that prevents the tape from being loaded 2. A damaged tape that cannot be loaded in the drive Take this action if the tape cartridge will not load in the drive: 1. Remove the tape cartridge and inspect it for damage. If damaged, discard it. 2. Try another cartridge in that tape drive. If it still fails, or if the cartridge is stuck in the drive, replace the drive sled. See "Replacing a Drive Sled" on page 7-43. Take this action if the tape is stuck in the drive: 1. Attempt to unload the tape from the drive using the host backup application that is currently using the drive, or using the remote or local UI. 2. If the cartridge will not unload, contact IBM Technical Support for assistance.

Table A-1. TapeAlert Flags Supported by the Ultrium Tape Drive (continued)

Flag Number	Flag	SNMP Trap	Description	Action Required
56	Unload Failure	No	When attempting to unload a tape cartridge, a drive hardware malfunction can prevent the tape from being ejected. The tape may actually be stuck in the drive.	Possible Causes: 1. A drive hardware error that prevents the tape from being unloaded 2. A damaged tape that cannot be unloaded from the drive Take this action if the tape will not unload from the drive: 1. Reset the drive. See "Resetting a Drive" on page 6-40 2. If resetting the drive does not recover the error, try to manually remove the tape cartridge from the drive and inspect it for damage. If damaged, discard it. 3. If the cartridge will not unload, contact your next level of support. Take this action if the tape is stuck in the drive: 1. Attempt to unload the tape from the drive using the host backup application that is currently using the drive, or via the remote or local UI. 2. If the cartridge will not unload, contact IBM Technical Support for assistance.
59	WORM Medium - integrity check failed	No	Set when the drive determines that the data on tape is suspect from a WORM point of view.	1. Copy the data to another WORM tape cartridge. 2. Discard the old WORM cartridge.
60	WORM Medium - Overwrite attempted	No	Set when the drive rejects a write operations because the rules for allowing WORM writes have not been met. Data can only be appended to WORM media. Overwrites to WORM media are not allowed.	Append the information on a WORM tape cartridge, or write the data to a non-WORM cartridge.

Appendix B. Sense Data

When a drive encounters an error, it makes sense data available. You can use IBM device drivers to examine the sense data and determine errors. Instructions for downloading, installing, and properly configuring the IBM device drivers are available in the *IBM Ultrium Device Drivers Installation and User's Guide*. The IBM device drivers may conflict with some commercial software applications unless properly configured. To avoid conflicts on Windows operating systems, refer to your device driver's procedures for setting the driver to manual startup mode. For applications that use Open Systems device drivers that are provided by IBM (for example, AIX, Linux, Sun Solaris, HP-UX, Windows 2003, and Windows 2000), the *Ultrium Device Drivers Installation and User's Guide* contains information about how to obtain sense data after an error has occurred.

If your application uses other device drivers, see the appropriate documentation for those drivers to obtain the sense data.

Raw sense data (as returned from the drive) is documented in the *IBM LTO Ultrium Tape Drive SCSI Reference*.

In addition to device drivers, other methods exist for obtaining sense data and error information. The sections that follow describe alternatives for gathering such information from the IBM AS/400, eServer iSeries, RS/6000®, and eServer pSeries® servers.

Library Sense Data

The following table lists the Additional Sense Codes (ASC) and Additional Sense Code Qualifiers (ASCQ) associated with the reported Sense Keys.

A sense key of 00h (no sense) has no ASC/ASCQ associated with it. A few ASC/ASCQs can be associated with more than one sense key. The sense keys that can give a particular ASC/ASCQ are indicated within the Sense Key column.

Table B-1. Library Sense Keys, ASC and ASCQ

Sense Key	ASC	ASCQ	Description
Recovered Error (01)	0Ah	00h	Error log overflow
	47h	00h	SCSI parity error

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Table B-1. Library Sense Keys, ASC and ASCQ (continued)

Sense Key	ASC	ASCQ	Description
Not Ready (02)	00h	17h	Drive cleaning requested
	04h	00h	Cause not reportable
	04h	01h	In progress becoming ready, scanning magazines, etc.
	04h	02h	Initializing command required
	04h	03h	Manual intervention required
	04h	07h	Operation in progress
	04h	12h	Offline
	04h	83h	Door open
	04h	85h	Firmware upgrade in progress
	04h	87h	The drive is not enabled
	04h	88h	The drive is busy
	04h	89h	The drive is not empty
	04h	9Ah	Drive fibre down
	04h	8Eh	The media changer is in sequential mode
	30h	03h	Cleaning in progress
	3Bh	12h	Magazine removed
Medium Error (03)	30h	00h	Incompatible media installed
	30h	03h	Cleaning tape installed
	30h	07h	Cleaning failure

Table B-1. Library Sense Keys, ASC and ASCQ (continued)

Sense Key	ASC	ASCQ	Description
Hardware Error (04)	81h	80h	Cannot initialize bar code reader
	81h	81h	No response from bar code reader
	81h	82h	No response from EEPROM
	81h	83h	Slave robotic generic problem
	81h	84h	Setting of gripper pic value failed
	81h	85h	Setting of slider pic value failed
	81h	86h	Setting of elevator pic value failed
	81h	87h	Setting of rotation pic value failed
	81h	88h	Setting of sled pic value failed
	81h	89h	Gripper blocked
	81h	8Ah	Slider blocked
	81h	8Bh	Elevator blocked
	81h	8Ch	Rotation blocked
	81h	8Dh	Sled blocked
	81h	8Eh	Cannot find gripper block
	81h	8Fh	Cannot find slider block
	81h	90h	Cannot find elevator block
	81h	91h	Cannot find rotation block
	81h	92h	Cannot find sled block
	81h	93h	Gripper outside range
	81h	94h	Slider outside range
	81h	95h	Elevator outside range
	81h	96h	Rotation outside range
	81h	97h	Sled outside range
	81h	98h	No cartridge present sensor found
	81h	99h	No slider home sensor found
	81h	9Ah	No rotation home sensor found
	81h	9Bh	No sled position sensor found
	81h	9Ch	The range of gripper is wrong
	81h	9Dh	The range of slider is wrong
	81h	9Eh	The range of elevator is wrong
	81h	9Fh	The range of rotation is wrong
	81h	A0h	The range of sled is wrong
	81h	A1h	Open import/export element failed
	81h	B0h	Slave robotic controller response timeout
	81h	B1h	NACK received from slave robotic controller
	81h	B2h	Slave robotic controller communication failed
	81h	B3h	Slave robotic controller urgent stop
	81h	B4h	Cartridge did not transport completely
	81h	B5h	Slave robotic controller does not respond on command

Table B-1. Library Sense Keys, ASC and ASCQ (continued)

Sense Key	ASC	ASCQ	Description
Hardware Error (04) (continued)	80h	C0h	Network init
	80h	C1h	Telnet interface
	80h	C2h	Webserver
	80h	C3h	EEPROM parameter
	80h	C4h	Cannot init LAN card
	80h	C5h	Write to EEPROM failed
	80h	C6h	Ping command did not reach target
	80h	C7h	Cannot upgrade from USB
	80h	D0h	ROM error
	80h	D1h	RAM error
	80h	D2h	NVRAM error
	80h	D3h	CTC error
	80h	D4h	UART error
	80h	D5h	Display error
	80h	D6h	Memory error
	80h	D7h	Fatal system error
	80h	D8h	dBase error
	80h	D9h	No SCSI IC detected
	80h	DAh	Different bar code labels
	80h	DBh	External cooling fan failure
	80h	DCh	Internal I2C bus error
	82h	F0h	Over temperature problem
	82h	F1h	Drive communication error
	82h	F2h	Drive sled not present
	82h	F3h	Drive broken: needs repair
	82h	F4h	Drive load timeout
	82h	F5h	Drive unload timeout

Table B-1. Library Sense Keys, ASC and ASCQ (continued)

Sense Key	ASC	ASCQ	Description
Illegal Request (05h)	1Ah	00h	Parameter length error
	20h	00h	Invalid command operation code
	21h	01h	Invalid element address
	24h	00h	Invalid field CDB
	3Dh	00h	SCSI invalid ID message
	25h	00h	Invalid LUN
	2Ch	00h	Command sequence error
	26h	00h	Invalid field in parameter list
	26h	01h	Parameter list error: parameter not supported
	26h	02h	Parameter value invalid
	26h	90h	Wrong firmware image, does not fit boot code
	26h	91h	Wrong personality firmware image
	26h	93h	Wrong firmware image, checksum error
	39h	00h	Saving parameters not supported
	3Bh	0Dh	Medium destination element full
	3Bh	0Eh	Medium source element empty
	3Bh	11h	Medium magazine not accessible
	3Bh	A0h	Medium transfer element full
	53h	02h	Library media removal prevented state set
	53h	03h	Drive media removal prevented state set
	44h	80h	Bad status library controller
	44h	81h	Source not ready
	44h	82h	Destination not ready
	44h	83h	Cannot make reservation
	44h	84h	Wrong drive type
	44h	85h	Invalid slave robotic controller request
	44h	86h	Accessor not initialized
Unit Attention (06h)	28h	00h	Not ready to ready transition
	28h	01h	Import/export element accessed
	29h	01h	Power on occurred
	29h	02h	SCSI Bus reset occurred
	29h	05h	Bus type changed to Single Ended (SE)
	29h	06h	Bus type changed to Low Voltage Differential (LVD)
	2Ah	01h	Mode parameters changed
	2Ah	10h	Time stamp changed
	3Bh	13h	Medium magazine inserted
	3Fh	01h	Microcode has changed
	53h	02h	Media removal prevented

Table B-1. Library Sense Keys, ASC and ASCQ (continued)

Sense Key	ASC	ASCQ	Description
Command Aborted (0Bh)	3Fh	0Fh	ECHO buffer overwritten
	43h	00h	SCSI message error
	47h	00h	SCSI parity error
	49h	00h	SCSI invalid message
	4Eh	00h	Overlapped command attempt

Drive Sense Data

LTO Ultrium 4 drives contain hardware which performs user data write encryption and read decryption, protecting all user data written to the medium from unauthorized use, provided it is integrated into a secure system design.

Table B-2. LTO Tape Drive Sense Data

Byte	Bit Address or Name							
	7	6	5	4	3	2	1	0
0	Address valid When set to 1, the info byte field contains a valid logical block address.	Error Code						
1	Segment Number (0)							
2	Filemark	EOM (end of medium)	ILI (Incorrect length indicator)	Reserved	Sense Key Description 0 - No sense 1 - Recovered error 2 - Not ready 3 - Media error 4 - Hardware error 5 - Illegal request 6 - Unit attention 7 - Data protect 8 - Blank Check 9 - Reserved A - Reserved B - Aborted command C - Reserved D - Volume overflow E - Reserved F - Reserved			
3	Information byte (most significant byte)							
4	Information byte							
5	Information byte							
6	Information byte (least significant byte)							
7	Additional Sense Length							
8-11	Command specific information							

Table B-2. LTO Tape Drive Sense Data (continued)

Byte	Bit Address or Name							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
12-13	Additional Sense Code (ASC) Additional Sense Code Qualifier (ASCQ) **Byte 12 Byte 13** **ASC ASCQ** 00 00 - No additional sense - The flags in the sense data indicate the reason for the command failure 00 01 - Filemark detected - A Read or Space command terminated early due to an FM The FM flag is set. 00 02 - EOM - A Write or Write File Marks command failed because the physical end of tape was encountered, or a Read or Space command encountered EOM The EOM flag is set 00 04 - BOM - A space command ended at Beginning of Tape The EOM bit is also set 00 05 - EOD - Read or Space command terminated early because End of Data was encountered 04 00 - Cause not reportable - A cartridge is present in the drive, but it is in the process of being unloaded 04 01 - Becoming Ready - A media access command was received during a front panel initiated load or an immediate reported load command 04 02 - Initializing Command Required - A cartridge is present in the drive, but is not logically loaded. A Load command is required 04 03 - Manual Intervention Required - A cartridge is present in the drive but could not be loaded or unloaded without manual intervention 0C 00 - Write Error - A Write operation has failed. This is probably due to bad media, but may be hardware related 11 00 - Unrecovered Read Error - A Read operation failed. This is probably due to bad media, but may be hardware related 11 12 - Auxiliary memory read error. The drive reported that it is unable to read the Auxiliary Memory in a WORM cartridge. 14 00 - Recorded Entity Not Found - A space or Locate command failed because a format violation prevented the target from being found. 14 03 - End Of Data not found - A Read type operation failed because a format violation related to a missing EOD data set 14 10 - Not Ready - Auxiliary memory not accessible. The drive is not able to become ready because it is unable to access the Auxiliary Memory in a WORM cartridge. 1A 00 - Parameter list length error - The amount of parameter data sent is incorrect 20 00 - Invalid Command Operation Code - The Operation Code in the command was not a valid Operation Code 24 00 - Invalid field in CDB - An invalid field has been detected in a Command Descriptor Block 25 00 - LUN not supported - The command was addressed to a non-existent logical unit number 26 00 - Invalid Field in Parameter List - An invalid field has been detected in the data sent during the data phase 27 00 - Write Protect - A Write type operation has been requested on a cartridge which has been write protected 28 00 - Not Ready to Ready Transition - A cartridge has been loaded successfully into the drive and is now ready to be accessed 29 00 - Reset - The drive has powered on, received a reset signal or a bus device reset signal since the initiator last accessed it 2A 01 - Mode Parameters Changed - The Mode parameters for the drive have been changed by an initiator other than the one issuing the command							

Table B-2. LTO Tape Drive Sense Data (continued)

Byte	Bit Address or Name							
	7	6	5	4	3	2	1	0
12-13	Additional Sense Code (ASC) - Additional Sense Code Qualifier (ASCQ) (Continued) **Byte 12 Byte 13** **ASC ASCQ** 30 00 - Incompatible Media Installed - A write type operation could not be executed because it is not supported on the cartridge type that is loaded. 30 01 - Unknown Format - An operation could not be carried out because the cartridge in the drive is of a format not supported by the drive 30 02 - Incompatible Format - An operation could not be completed because the Logical Format is not correct 30 03 - Cleaning Cartridge Installed - An operation could not be carried out because the cartridge in the drive is a cleaning cartridge 30 07 - Cleaning Failure - A cleaning operation was attempted, but could not be completed for some reason 30 0C - Data Protect - WORM overwrite attempted. The drive rejected a write operation because it would have resulted in an overwrite. Overwrite is not allowed on WORM media. 30 0D - Medium Error - WORM integrity check. The drive rejected a Read or Write operation because the cartridge is a suspicious WORM cartridge. 31 00 - Media format corrupted - Data could not be read because the format on tape is not valid, but is a known format. A failure occurred attempting to write the FID 37 00 - Rounded parameter - A Mode Select command parameter has been rounded because the drive can not store it with the accuracy of the command. 3A 00 - Media Not Present - A media access command has been received when there is no cartridge loaded 3B 00 - Sequential Positioning Error - A command has failed and left the logical position at an unexpected location 3D 00 - Invalid bits in identify Message - An illegal Identify Message has been received at the drive at the start of a command 3E 00 - Logical Unit has not Self-Configured - The drive has just powered on and has not completed its self test sequence and can not process commands 3F 01 - Code Download - The firmware in the drive has just been changed by a Write Buffer command 40 xx - Diagnostic failure - A diagnostic test has failed. The xx (ASCQ) is a vendor specific code indicating the failing component. 43 00 - Message Error - A message could not be sent or received due to excessive transmission errors 44 00 - Internal target failure - A hardware failure has been detected in the drive that has caused the command to fail 45 00 - Select/Reset Failure - An attempt to reselect an initiator in order to complete the command has failed 4B 00 - Data Phase Error - A command could not be completed because too many parity errors occurred during the Data phase 4E 00 - Overlapped Commands - An initiator selected the drive even though it already had a command outstanding in the drive 50 00 - Write Append Error - A write type command failed because the point at which to append data was unreadable 51 00 - Erase failure - An Erase command failed to erase the required area on the media							

Table B-2. LTO Tape Drive Sense Data (continued)

Byte	Bit Address or Name							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
12-13	Additional Sense Code (ASC) - Additional Sense Code Qualifier (ASCQ) (Continued) **Byte 12 Byte 13** **ASC ASCQ** 52 00 - Cartridge fault - A command could not be completed due to a fault in the tape cartridge 53 00 - Media Load/Eject Failed - (Sense Key 03) An attempt to load or eject the cartridge failed due to a problem with the cartridge. 53 00 - Media Load/Eject Failed - (Sense Key 04) An attempt to load or eject the cartridge failed due to a problem with the drive 53 02 - Media Removal Prevented - An Unload command has failed to eject the cartridge because media removal has been prevented 5D 00 - Failure Prediction Threshold - Failure Prediction thresholds have been exceeded indicating that a failure may occur soon 5D FF - Failure Prediction False - A Mode Select command has been used to test for Failure Prediction system. 82 82 - Drive requires cleaning - The drive has detected that a cleaning operation is required to maintain good operation 82 83 - Bad Code Detected - The data transferred to the drive during a firmware upgrade is corrupt or incompatible with drive hardware							

Table B-2. LTO Tape Drive Sense Data (continued)

Byte	Bit Address or Name							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
12-13	Additional Sense Code (ASC) - Additional Sense Code Qualifier (ASCQ) (Continued) **Byte 12 Byte 13** **ASC ASCQ** **Sense Key 0 (No Sense)** EE 13 - Encryption - Key Translate EF 13 - Encryption - Key Translate EKM **Sense Key 3 (Medium Error)** 30 02 - Encryption - Encryption feature is not enabled so format/processing is not supported EE 60 - Encryption - Proxy Command Error EE D0 - Encryption - Data Read Decryption Failure EE D1 - Encryption - Data Read after Write Decryption Failure EE E0 - Encryption - Key Translation Failure EE E1 - Encryption - Key Translation Ambiguous EE F0 - Encryption - Decryption Fenced (Read) EE F1 - Encryption - Encryption Fenced (Write) **Sense Key 4 (Hardware Error)** EE 0E - Encryption - Key Service Timeout EE 0F - Encryption - Key Service Failure 40 00 - Encryption - Failure Hardware, POST or Module Failure **Sense Key 5 (Illegal Request)** EE 00 - Encryption - Key Service Not Enabled EE 01 - Encryption - Key Service Not Configured EE 02 - Encryption - Key Service Not Available EE 10 - Encryption - Key Required EE 20 - Encryption - Key Count Exceeded EE 21 - Encryption - Key Alias Exceeded EE 22 - Encryption - Key Reserved EE 23 - Encryption - Key Conflict EE 24 - Encryption - Key Method Change EE 25 - Encryption - Key Format Not Supported EE 26 - Encryption - Unauthorized Request - dAK EE 27 - Encryption - Unauthorized Request - dSK EE 28 - Encryption - Unauthorized Request - eAK EE 29 - Encryption - Authentication Failure EE 2A - Encryption - Invalid RDKi EE 2B - Encryption - Key Incorrect EE 2C - Encryption - Key Wrapping Failure EE 2D - Encryption - Sequencing Failure EE 2E - Encryption - Unsupported Type EE 2F - Encryption - New Key Encrypted Write Pending EE 30 - Encryption - Prohibited Request EE 31 - Encryption - Key Unknown EE 42 - Encryption - EKM Challenge Pending EE E2 - Encryption - Key Translation Disallowed EE FF - Encryption - Security Prohibited Function EF 01 - Encryption - Key Service Not Configured 26 11 - Encryption - Incomplete Key - Associate Data Set 26 12 - Encryption (T10) - Vendor Specific Reference Key Not Found 55 08 - Encryption (T10) - Maximum Number of Supplemental Keys Exceeded							

Table B-2. LTO Tape Drive Sense Data (continued)

Byte	Bit Address or Name							
	7	6	5	4	3	2	1	0
12-13	**Sense Key 6 (Unit Attention)** EE 12 - Encryption - Key Change Detected EE 18 - Encryption - Changed (Read) EE 19 - Encryption - Changed (Write) EE 40 - Encryption - EKM Identifier Changed EE 41 - Encryption - EKM Challenge Changed EE 50 - Encryption - Initiator Identifier Changed EE 51 - Encryption - Initiator Response Changed 2A 11 - Encryption - Data Encryption Parameters Changed by Another I_T Nexus 2A 12 - Encryption - Data Encryption Parameters Changed by Vendor Specific Event **Sense Key 7 (Data Protect)** EF 10 - Encryption - Key Required EF 11 - Encryption - Key Generation EF 13 - Encryption - Key Translate EF 1A - Encryption - Key Optional EF C0 - Encryption - No Operation 26 10 - Encryption - Data Decryption Key Fail Limit 2A 13 - Encryption - Data Encryption Key Instance Counter Has Changed 74 00 - Security Error 74 01 - Encryption - Unable to Decrypt Data 74 02 - Encryption - Unencrypted Data Encountered While Decrypting 74 03 - Encryption - Incorrect Data Encryption Key 74 04 - Encryption - Cryptographic Integrity Validation Failed 74 05 - Encryption - Error Decrypting Data							
14	FRU code							
15	SKSV	C/D	Reserved		BPV When set to 1, the bit pointer is valid.	Bit pointer		
16 -17	SKSV = 0: First Error Fault Symptom Code (FSC). SKSV = 1: Field Pointer							
18-19	First Error Flag Data							
20	Reserved (0)							
21					CLN	Reserved	Reserved	VolValid
22-28	Volume Label							
29	Current Wrap							
30-33	Relative LPOS							
34	SCSI Address							
35	Frame number				Drive number			

The descriptions below serve only as an overview of sense reporting in the tape drive. This tape drive conforms to all sense field reporting as specified in the SCSI standards.

Note:

1. The Error Code field (Byte 0) is set to 70h to indicate a current error, that is one associated with the most recently received command. It is set to 71h to indicate a deferred error which is not associated with the current command.
2. The segment number (Byte 1) is zero since the Copy, Compare, and Copy and Verify commands are not supported.
3. The File Mark flag (Byte 2, bit 7) is set if a Space, Read, or Verify command did not complete because a file mark was read.
4. The End of Media (EOM) flag (Byte 2, bit 6) is set if a Write or Write File Marks command completed in the early warning area. Spacing into BOM also causes this flag to be set. It is also set on an attempt to read or space past EOD, or if an attempt is made to space into Beginning of Media.
5. The Illegal Length Indicator (ILI) flag (Byte 2, bit 5) is set if a Read or Verify ended because a block was read from tape that did not have the block length requested in the command.
6. The Information Bytes (Bytes 3-5) are only valid if the Valid flag is set. This occurs only for current errors and not for deferred errors.
7. The Field Replaceable Unit field (Byte 14) is set to either zero or to a non-zero, vendor-specific code indicating which part of the drive is suspected of causing the failure.
8. The Clean (CLN) flag (Byte 21, bit 3) is set if the drive needs cleaning and clear otherwise.
9. The Volume Label Fields Valid (VolValid) bit (Byte 21, bit 0) is set if the Volume Label being reported is valid.
10. The Volume Label field (Bytes 22-28) reports the volume label if a cartridge is loaded in the drive and Volume Label Fields Valid is set.
11. The Current Wrap field (Byte 29) reports the physical wrap of the tape. The least significant bit reflects the current physical direction. A 0 means that the current direction is away from the physical beginning of the tape. A 1 means that the current direction is towards the physical beginning of the tape.
12. Relative LPOS fields (Bytes 30-33) reports the current physical position on the tape.
13. SCSI Address field (Byte 34) reports the SCSI Bus Address for the drive. Values returned range from 00h to 0Fh.
14. This field (Byte 35) contains the frame and drive number, passed across the RS-422 serial interface.

Appendix C. Library Diagrams

"Power Requirements"

"Control Module Electrical System" on page C-6

"Control Module and Expansion Module Electrical System" on page C-7

"Interpreting Library Diagrams" on page C-2

The library power system includes redundant +48 VDC power supplies with current sharing outputs. The same power system is used in both control modules (CM) and expansion module (EM). The redundant configuration power supplies may be hot swapped without interrupting library operation. Each supply in a CM and EM includes its own input AC line cord. During redundant operation, each supply carries one-half the power load. If a line cord or power supply fails, the second supply sources the complete power load. Optionally, a single power supply and line cord may be installed if redundant power is not required. The second power supply slot is physically covered in this configuration. The library may be upgraded to redundant power at a later time.

The power supply output voltage tolerance is from 48.2 to 53.0 volts. The power supply has an over voltage shut down set at 59 volts providing a 1 volt margin below the maximum allowable UL low voltage limit of 60 volts.

Library power is controlled in two places. A switch on the rear of each power supply shuts down power at the input of the individual power supplies. A front panel power enable switch controls the power supply output for all CM and EM power supplies. A library connected to AC line voltage will be in standby mode with power supply ON but outputs turned OFF when the front panel power enable switch is turned OFF. When the power enable switch is turned ON, the power supply output and the library electronics power are ON. The Library Control Blade (LCB) may turn the power system OFF using the PC interface.

Power Requirements

The tables below summarizes the library power requirements. Each library modules uses a 350 watt power supply. Two 350 watt supplies are used when redundant power is selected.

Table C-1. Control module (CM) power requirements

Item	Volts	Amps	DC Watts	AC Watts
Servo PCB			9.41	11.07
Accessor Motors	48	4*0.75	144	169.41
Door/Display			11.76	13.84
Drive Sleds - 2x50			100	117.65
Drive Sled 1x1 (10w)			20	23.5
LCB			47.06	55.36

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Table C-1. Control module (CM) power requirements (continued)

Item	Volts	Amps	DC Watts	AC Watts
Total			332.23	390.83
Power Supply			350 watts	

Table C-2. Typical expansion module (EU) power requirements

Item	Volts	Amps	DC Watts	AC Watts
Drive sleds - 4x50			200	235.29
Drive Sled 1x1 (10w)			40	23.5
Total			320	352.91
Power Supply			350 watts	

Interpreting Library Diagrams

Each component has a specific role that is critical in the library's overall performance. Components serve either a logic (i.e., processes data) or interconnect (i.e., carries signals between components) function within the library.

The following table lists the library components, their module location(s), and their overall function (i.e., logic or interconnect):

Component	Module	Function
Library Control Blade (LCB)	Control module	Logic
Backplane Connect boards (BCB1, BCB2, BCB3)	Control module (BCB1) & expansion modules (BCB2 & BCB3)	Interconnect
Power supply	Control module & expansion module (with drives)	Power
Servo & Motor Driver Boards (SMD1 & SMD2)	Control module	Logic (SMD1) & interconnect (SMD2)
Door & Import/Export Board (DIEB)	Control module	Logic
Drive Sled Interconnect Boards (DSIB1 & DSIB2)	Control module (DSIB1) & expansion module (DSIB1 or DSIB2)	Interconnect

Library Control Blade (LCB)

The LCB1 is a critical logic component of the library. It is only located in the control module. The LCB1 serves as the "brain" or primary control board, for library operations. It communicates with the host server's backup application and issues commands in communicating with various library components:

- Issues motion commands for the servo and motor driver board to execute over the LCB1 to SMD1/SMD2 communication interface
- Library CAN network connects the LCB1 to the motion processor on SMD1

- Receives power and monitors the power supply status using the I^2C (inter-integrated) interface to report any error conditions
- Controls the user interface (LCD display and touch screen) and input/output (I/O) station via the DIEB
- Controls media movement and monitors tape drive status

Backplane Connect Boards (BCBs)

The Backplane Connect Board (BCB) is an interconnect device for various library components. BCBs are found in both the control module and any expansion module. There are two versions of BCB:

- BCB1 - control module
- BCB3 - 9U expansion module

The "Control Module and Expansion Module Electrical System" on page C-7 illustrates the key communication and power paths between BCB boards and other library components:

- LCB1 attaches to the BCB1 board
- BCB1 carries signals from the LCB1 to the servo control and motor driver board (SMD1)
- The door and display board (DIEB) signals from the I/O Station pass through the BCB1 to the LCB1. BCB2 and BCB3 function similarly in supporting the expansion module's I/O Station.

Power Supplies

There is always at least one power supply in the control module, which provides _48 volts DC power to the library. If there is one or more drives in the expansion module, then this module also must have a power supply. Each module's power supply consists of an AC cable supplying electrical current from a wall outlet and a +48 V DC power supply. The power supply in the control module powers all library components within the control module including its drives. The expansion module's power supply provides power for the drives and BCB boards within the expansion module.

In the control module, the power supply's rear panel switch provides power to the library. This power supply connects with the BCB1 board in the library, which interconnects with the LCB1 in communicating the library's power status. The BCB1 board in the control module channels power to the Servo & Motor Driver Boards (SMD1 & SMD2), which operate the robotics assembly. The power supplies in both the control and expansion modules connect with that module's Drive Sled Interconnect Board (DSIB) in providing power to the drive sleds.

The control module's front power enable switch is located near the operator panel on the front of the library. It is connected to the Door & Import/Export Board (DIEB), which is only found in the control module. This front power switch enables power to the operator panel interface and the library firmware and robotics assembly. The control module's power supply provides power to the DIEB via the BCB interconnect.

Servo & Motor Driver Boards (SMDs)

There are two Servo & Motor Driver Boards (SMDs) in the control module that perform key functions in operating the robotics assembly for selecting and moving

barcode labeled cartridges. The SMD1 board is a logical device that communicates with the LCB1 in moving media within the library. The SMD2 board is an interconnect device between the SMD1 board and the barcode scanner and sensors. This topic further describes these SMD boards.

The SMD1 board controls and drives the 4 motors of the library robotics:

- • X motor - controls horizontal motion
- • Y motor - controls vertical motion
- • Theta motor - pivots the picker assembly for media selection
- • Reach motor - extends and contracts the picker arm assembly in moving media into and out of a slot or drive

Note: Although the X, Y, and Theta (pivot) motors can move concurrently, the reach motor cannot operate while other motors operate.

The picker assembly contains the X, Theta, and Reach motors. Also, the picker assembly contains the SMD1 and SMD2 boards as well as the barcode scanner and target sensors.

The motion processor chip is the ”heart” of the SMD1 board, performing these functions:

- • This chip supports the 4 servo motion axes using AC brushless motors, which extend the library's life over motors with brushes.
- • It controls the motion velocity and acceleration and calculates the trajectory for moving media.
- • A barcode scanner connected to SMD1 via the SMD2 interconnect card allows reading cartridge barcodes and specifies the EM type barcode (5U or 9U). The SMD1 controls the barcode scanner and receives barcode label data.
- • It triggers the Y motor to move the robot in order to locate a desired barcode on a cartridge. The robot will move to the bottom of a column and cartridges will be scanned as the Y axis motor moves the robot up the column.
- • It finds a home signal input for each motor, registering a motor's home location in the library. During teach operations the teach sensor on the robot is used for position detection. The LCB1 will monitor the teach sensor state using CAN to read the detected position.

The SMD2 board interconnects with the SMD1 board and the robotics assembly in selecting and moving media. The SMD2 performs these functions:

- • Interfaces between the picker and the barcode scanner carrying transmit and receive signals.
- • Provides connectivity for Teach, Reach Home, and Cartridge Present signals from sensors.
- • Distributes power from the SMD1 board to the picker's sensors and the barcode scanner.

Door & Import/Export Board (DIEB)

The Door & Import/Export Board (DIEB) is only found in the control module. The DIEB performs these functions:

- • Controls the local (operator panel) interface.
- • Interfaces the LCB1 with the LCD touch-screen interface.

- • Controls the import/export station using the I2C interface with the LCB1. Then the LCB1 registers output to control the on-board buzzer that provides audio feedback for the library operator.
- • The DIEB as well as the LCB1 provide critical environmental monitoring.
- • Sends voltage information to the LCB1 using the I2C interface. This interface also reads the card's version to identify existing hardware and firmware version. Then if hardware changes, the firmware can be updated too.
- • Power conversion hardware on DIEB converts the +48 VDC input voltage to the required voltage levels of components on this board.
- • The front panel power switch interfaces with the control module's Backplane Connect Board (BCB1), providing power for enable/disable commands.

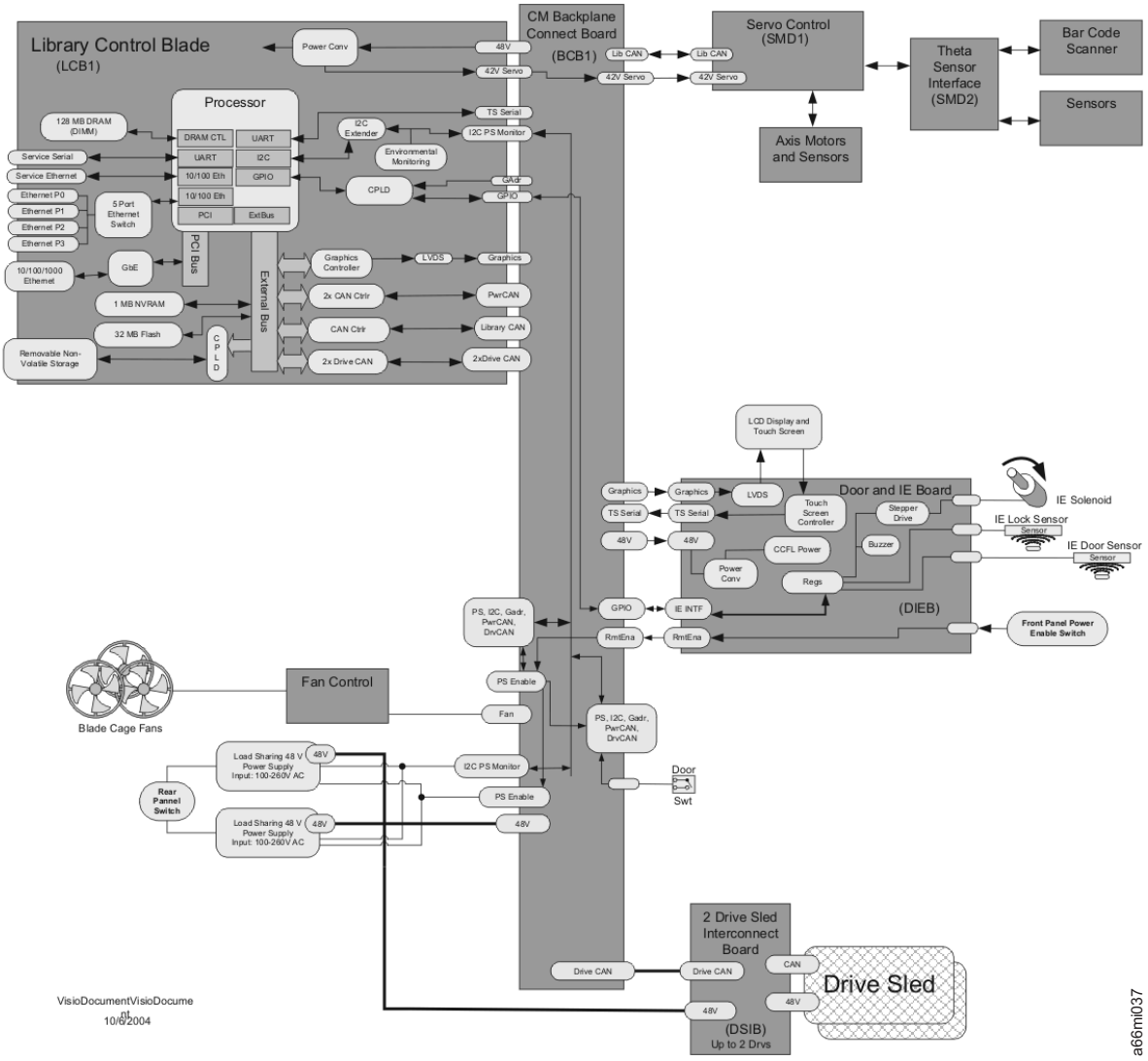
Drive Sled Interconnect Board (DSIB)

The Drive Sled Interconnect Board (DSIB) functions as an interconnect board between drive sleds and the library for power and drive communications. A DSIB board is required in all modules, regardless of whether the module contains drive sleds. The Predator library only supports full-height drive slots, such as LTO drives.

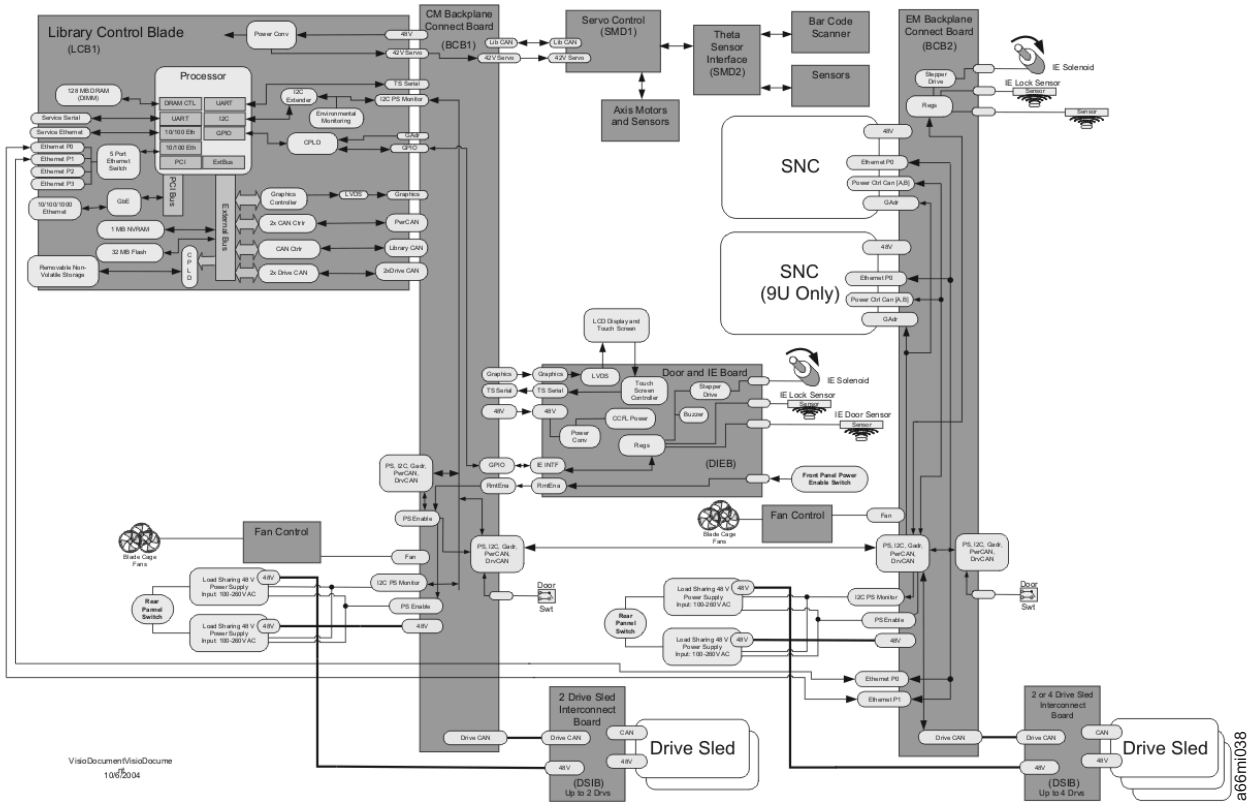
Here are some considerations regarding the DSIB:

- • Connects with the LCB1 in receiving tape drive commands and routing status and error messages, with signals being routed through the BCB1 (control module) or BCB2/BCB3 (expansion module).
- • Drive input power is supplied from the module power supply and current is limited on the DSIB.
- • There are two versions of DSIB boards:
  - o DSIB1 supports 2 drive sleds and is utilized in the 5U CMand 5U EM.
  - o DSIB2 supports 4 drive sleds and is utilized in the 9U EM.
  - o For a 14U library with 6 drive sleds, both DSIB1 and DSIB2 boards are required.

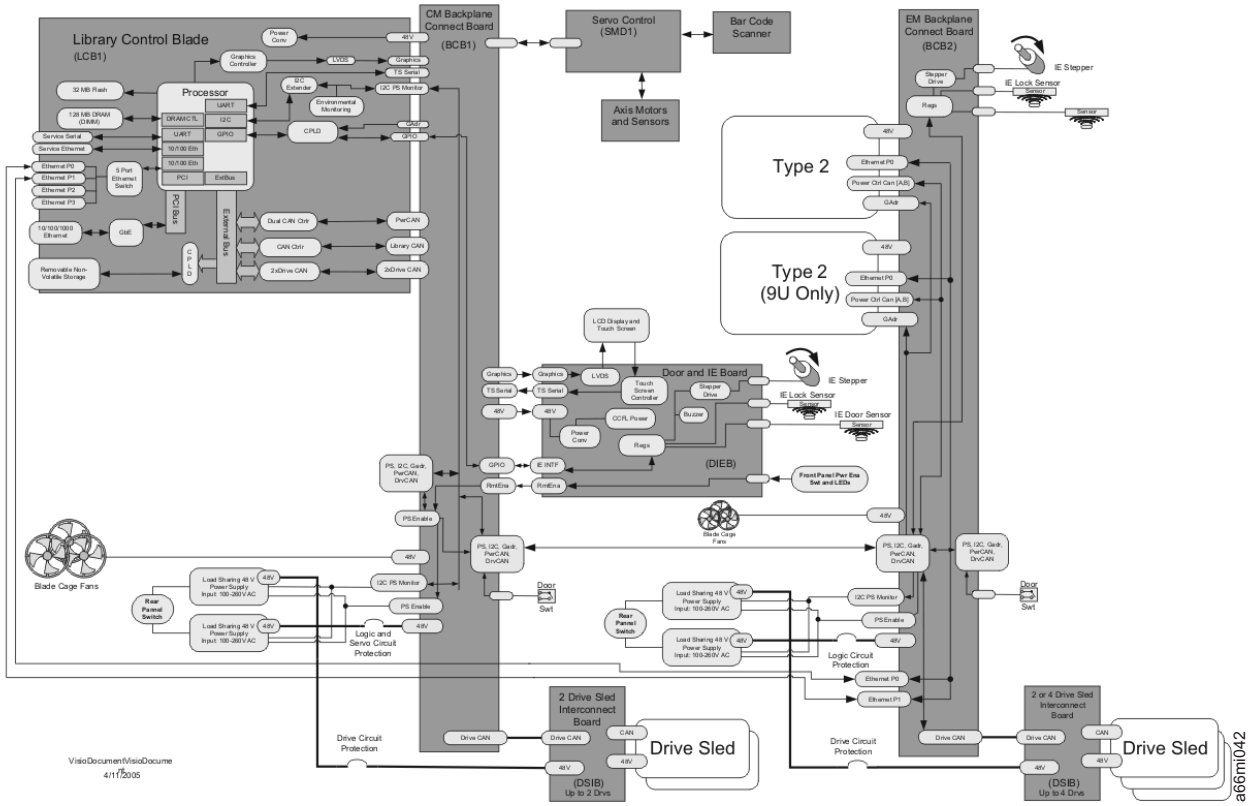
Control Module Electrical System



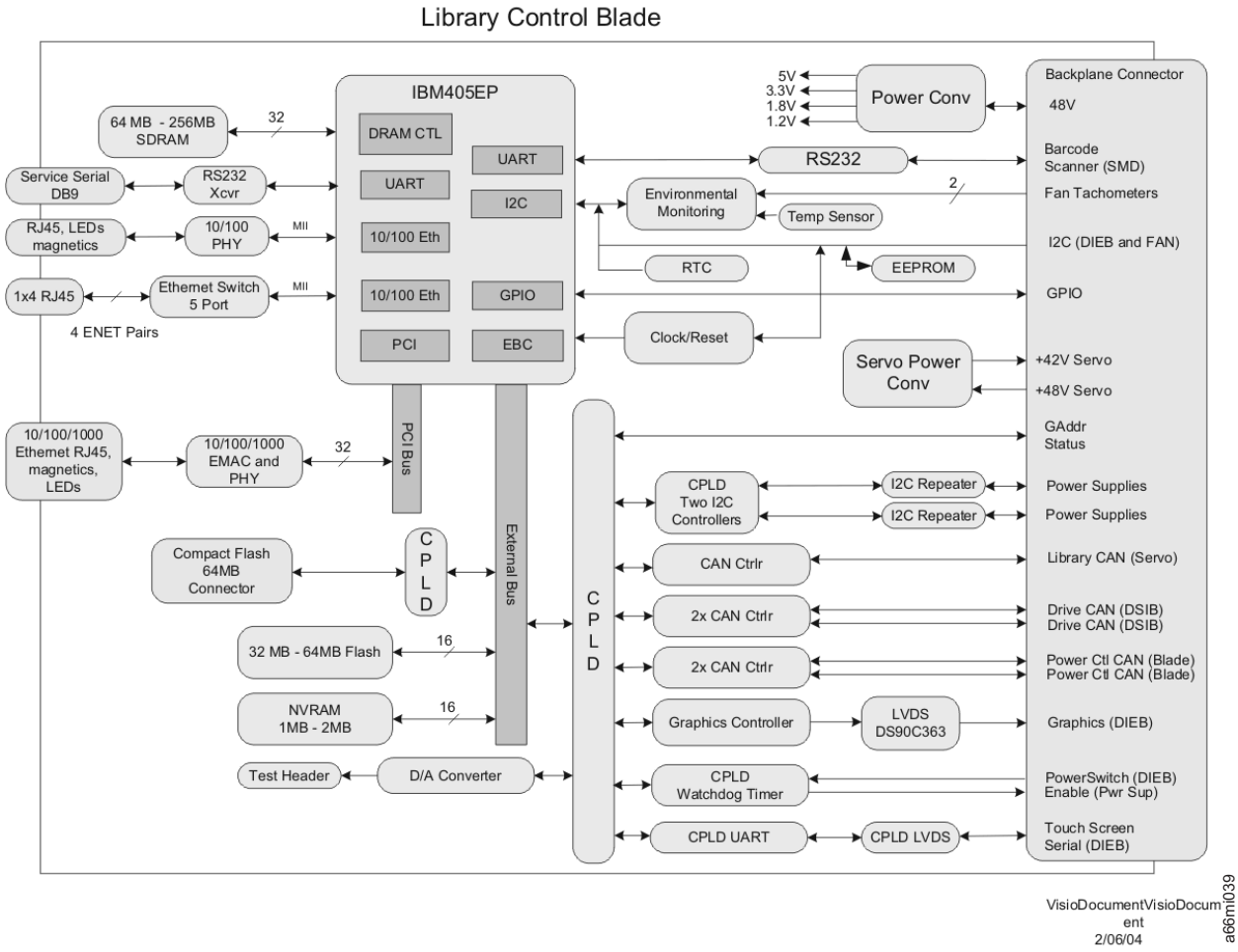
Control Module and Expansion Module Electrical System



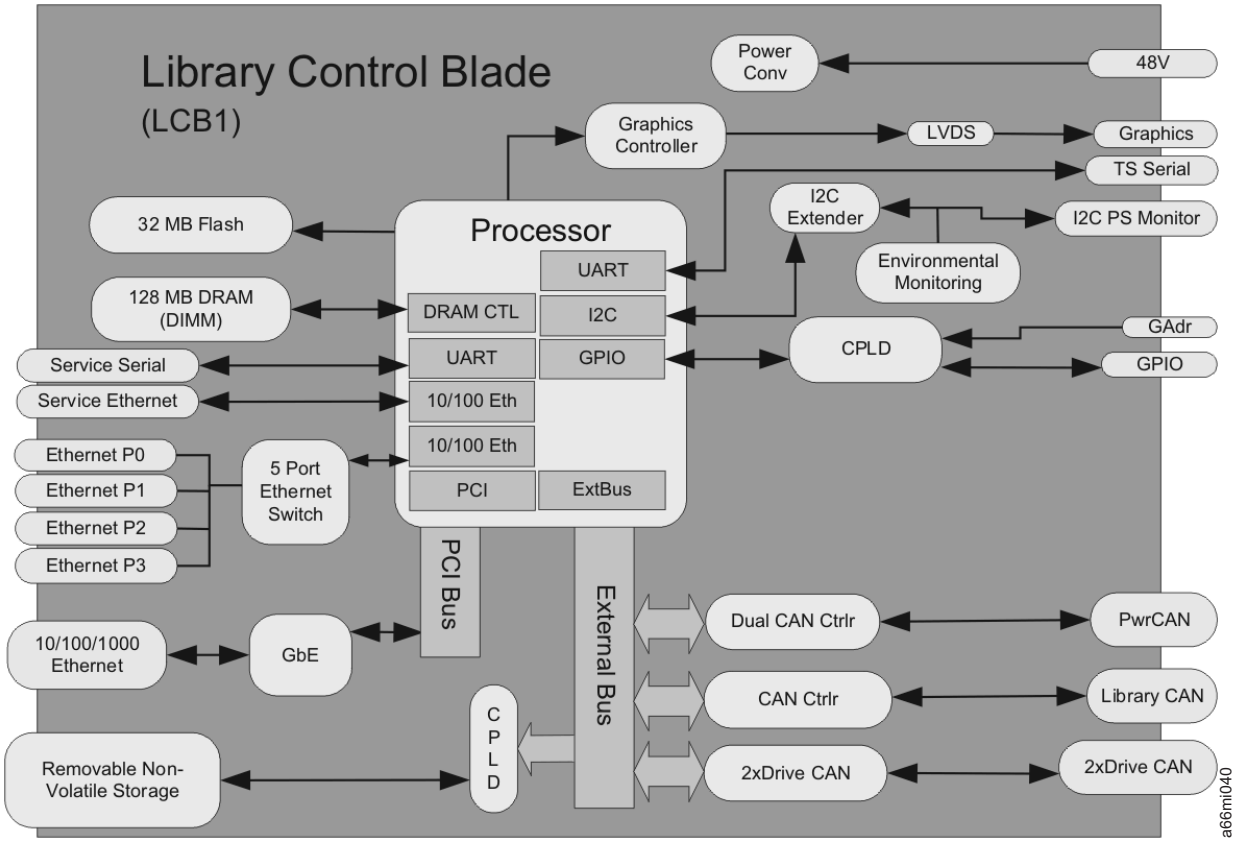
Library Electrical Block



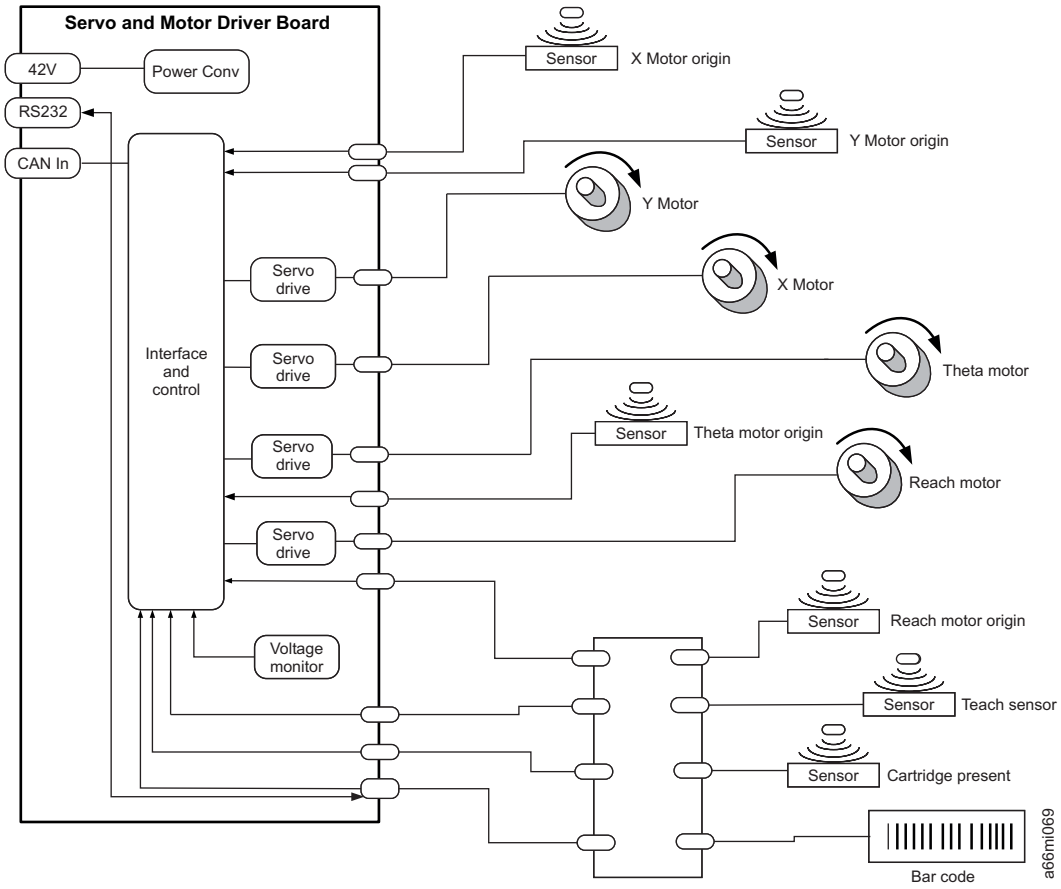
Library Control Blade



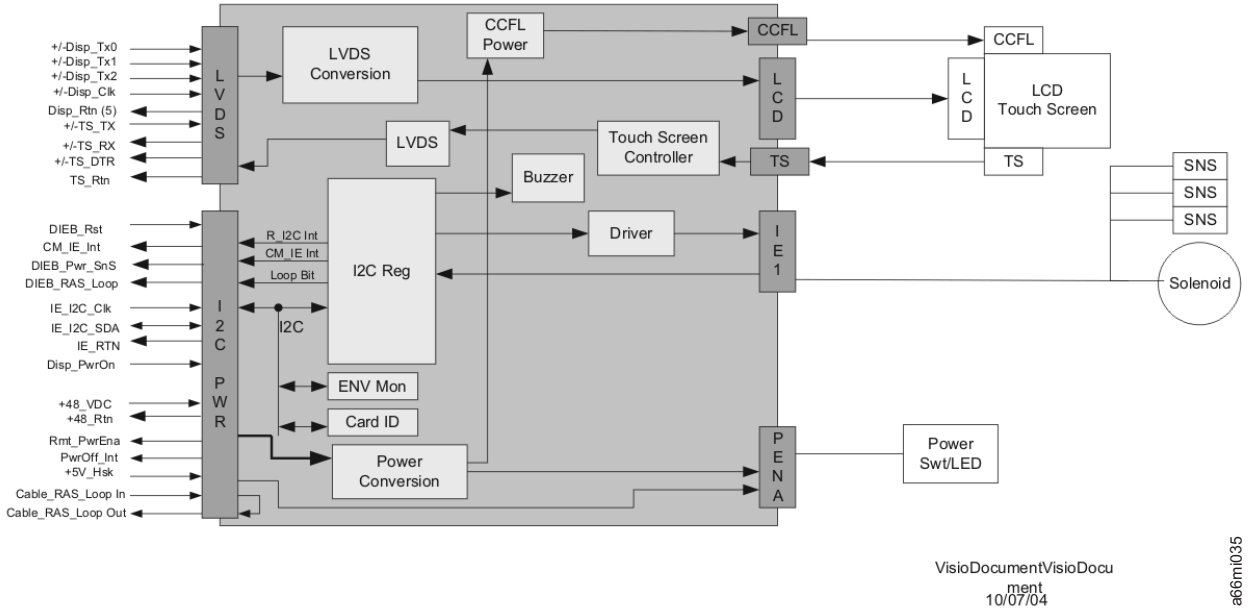
Library Control Blade Functions



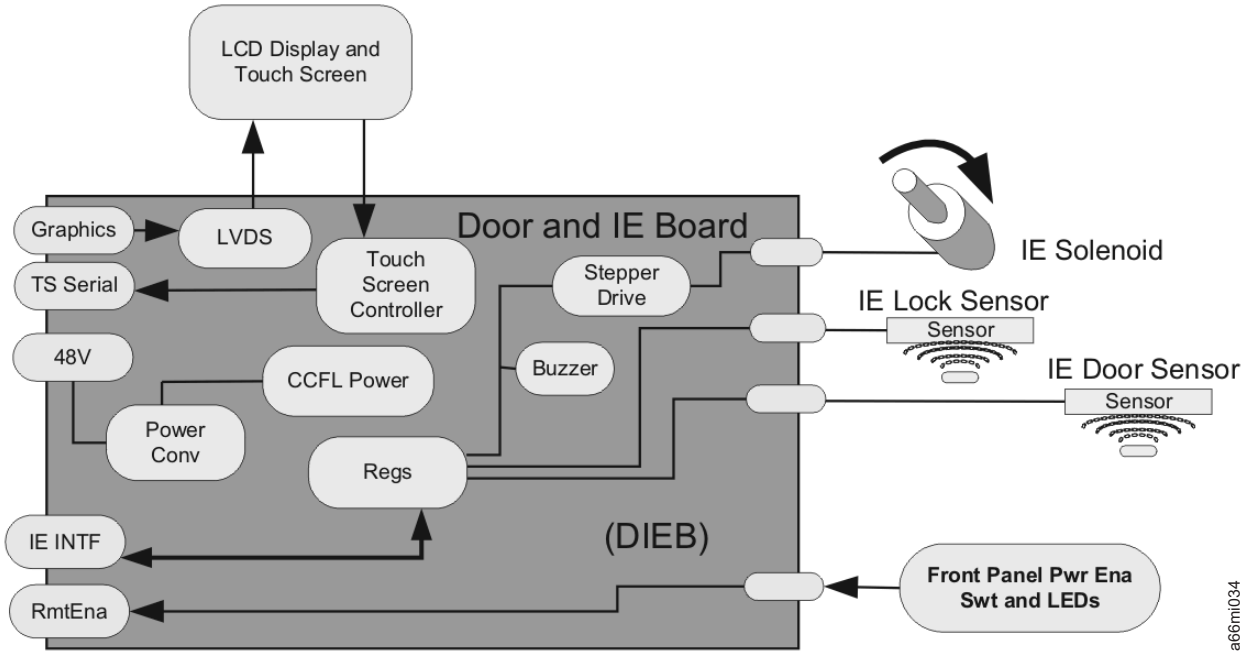
Accessor Control Block



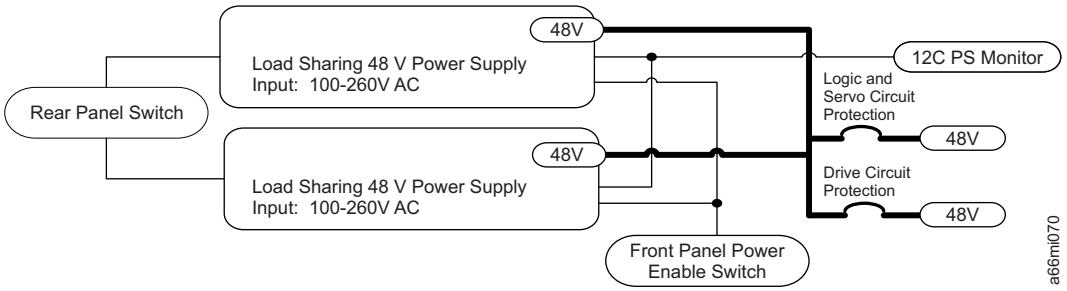
Door and Import/Export Board (DIEB)



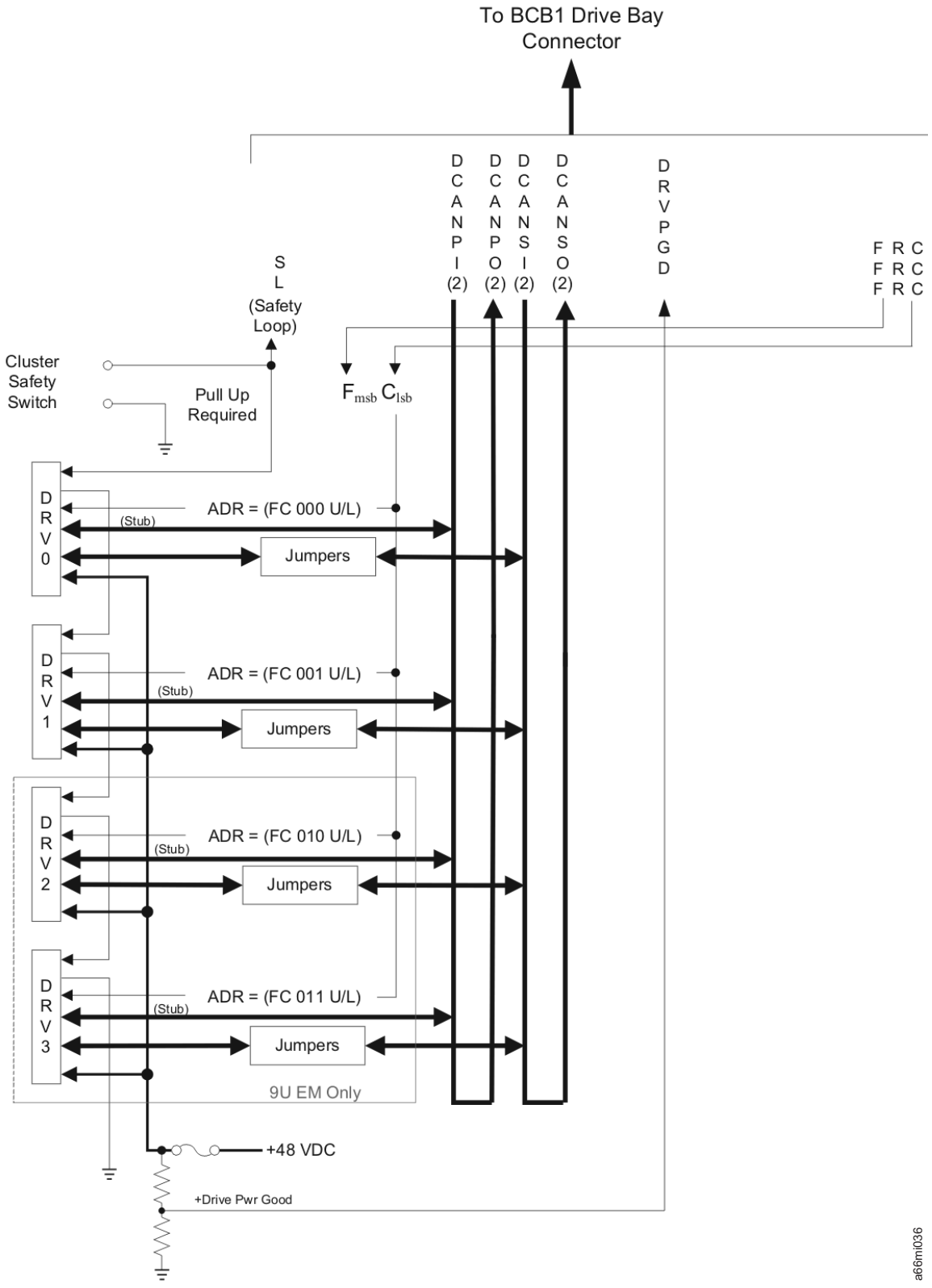
Door and Display Block



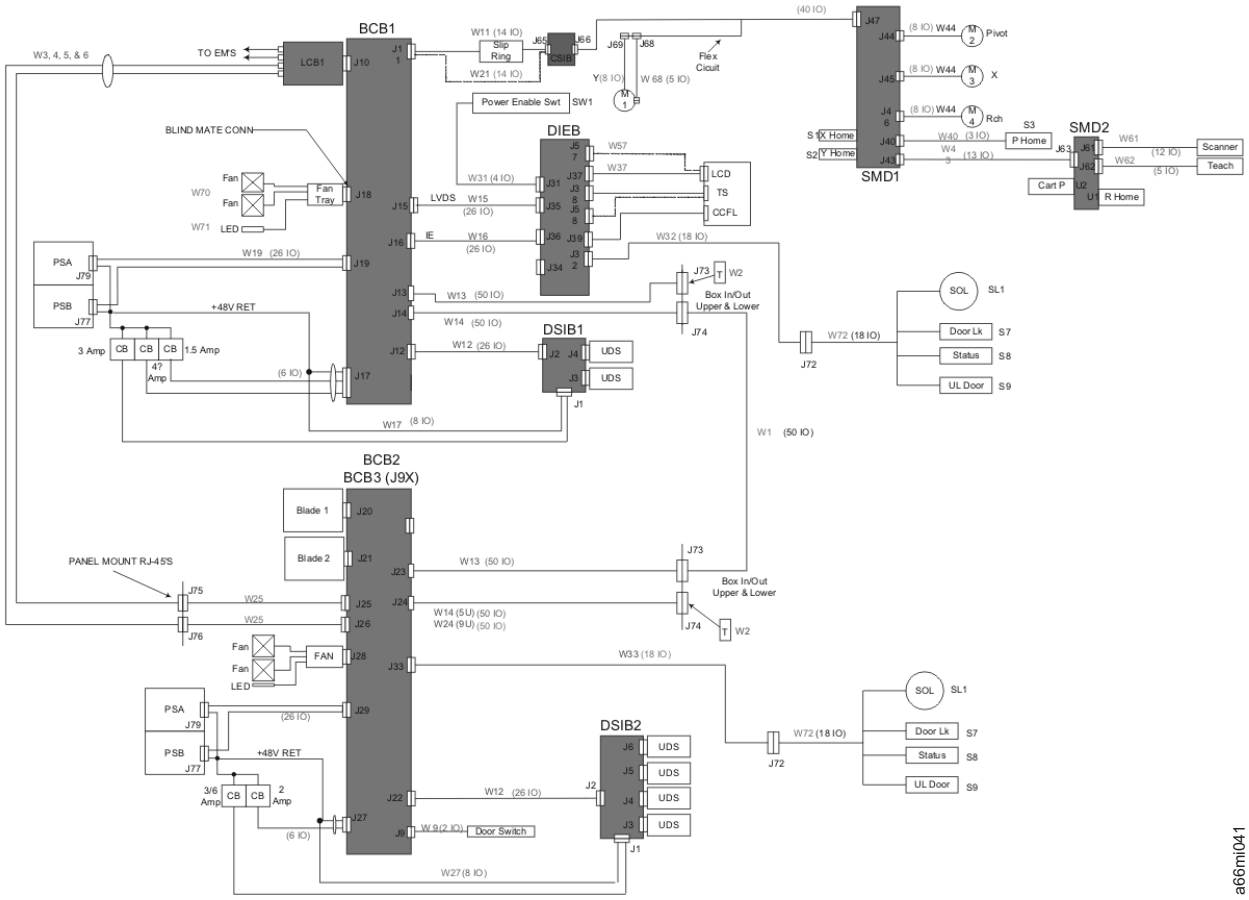
Power System Block Diagram



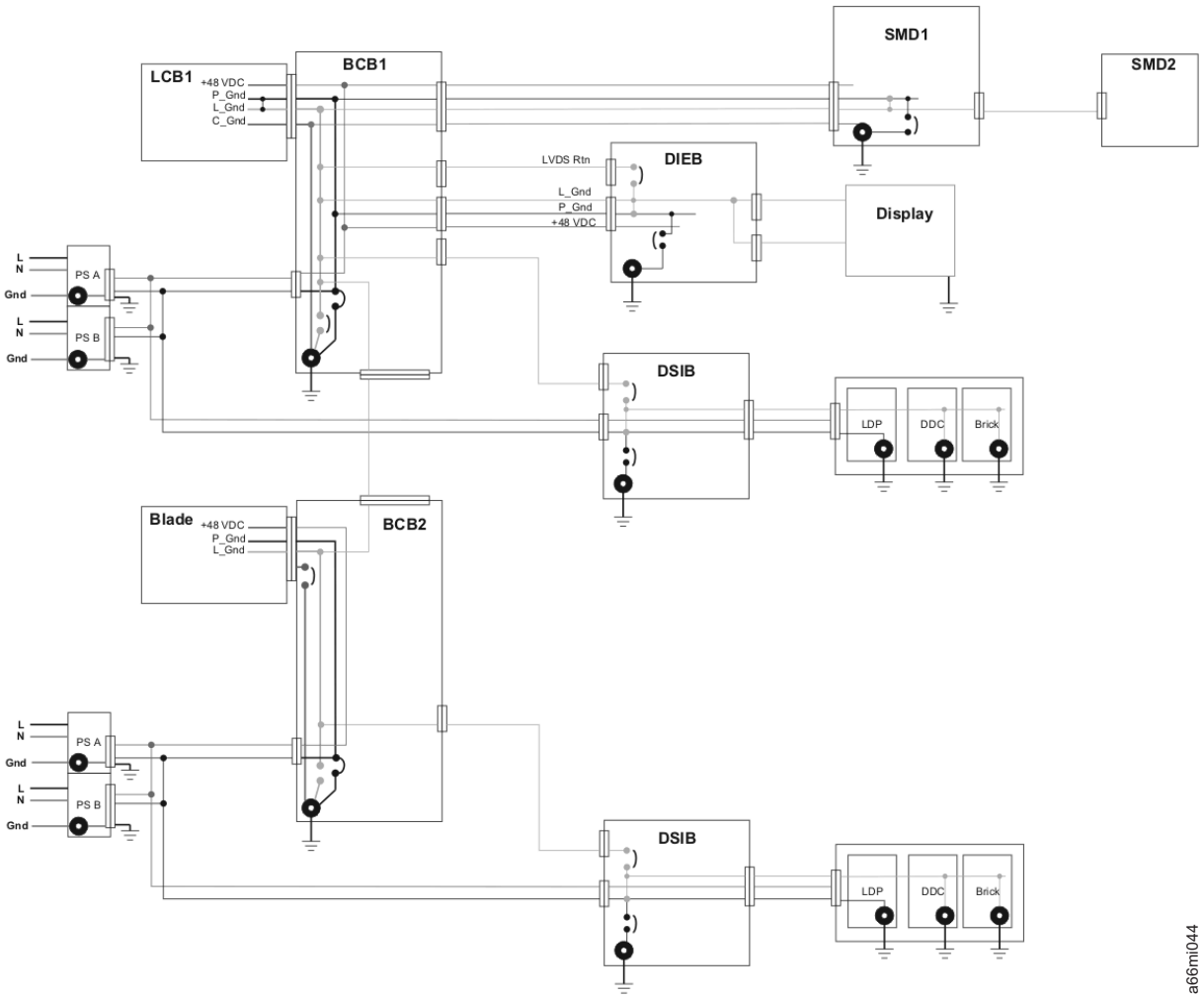
Drive Sled Interconnect Board (DSIB)



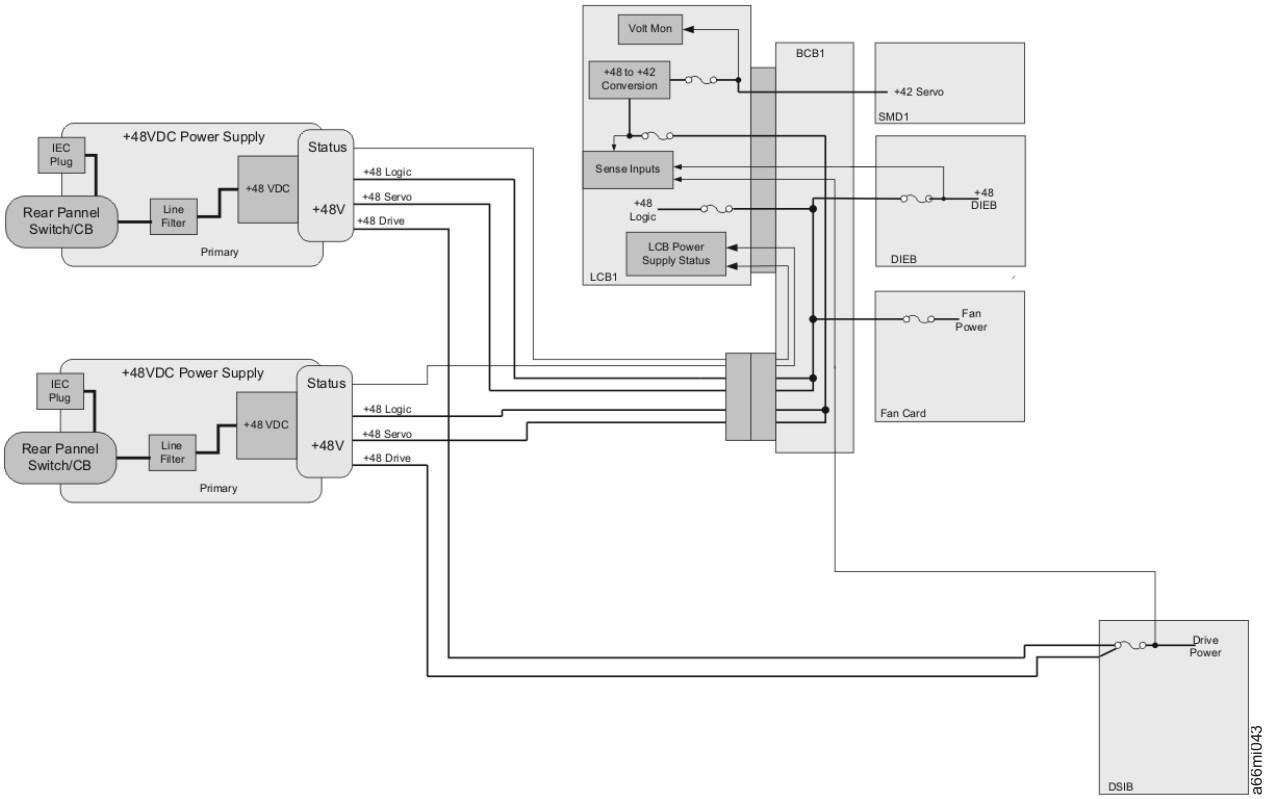
Library Cables



Library System Grounding



Library Power System


+48VDC Power Supply
IEC Plug
Rear Pannel Switch/CB
Line Filter
+48 VDC
Status
+48V
Primary
+48 Logic
+48 Servo
+48 Drive
+48VDC Power Supply
IEC Plug
Rear Pannel Switch/CB
Line Filter
+48 VDC
Status
+48V
Primary
+48 Logic
+48 Servo
+48 Drive
Volt Mon
+48 to +42 Conversion
Sense Inputs
+48 Logic
LCB Power Supply Status
LCB1
BCB1
+42 Servo
SMD1
+48 DIEB
DIEB
Fan Power
Fan Card
Drive Power
DSIB
a66mi043

Appendix D. Using Ultrium Drives

The 3576 Tape Library supports Ultrium SCSI, SAS, and Fibre Channel tape drives.

"Single-character Display (SCD)" on page D-2

"Status Light" on page D-2

"Unload Button" on page D-4

"Inserting a Tape Cartridge" on page D-4

"Removing a Tape Cartridge" on page D-5

"Using Ultrium Media" on page D-5

"Diagnostic and Maintenance Functions" on page D-26

"Drive Error Codes" on page D-42

"Resolving Tape Drive Problems" on page D-48

"Fixing SCSI Bus Problems" on page D-51

"Fixing Fibre Channel Errors" on page D-54

"Fixing SAS Interface Problems" on page D-57

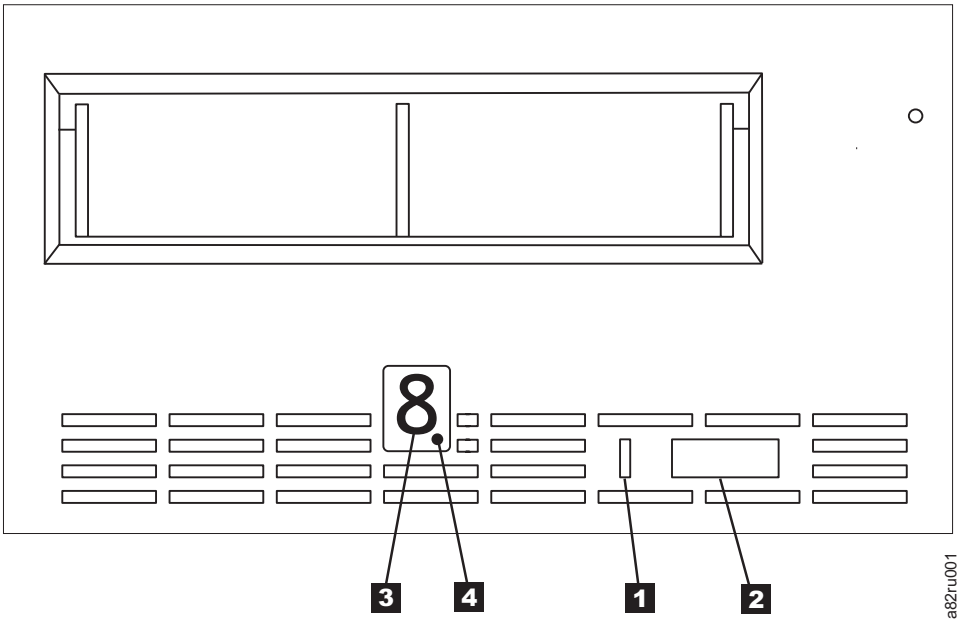


Figure D-1. Front panel of the drive

1	Status Light	3	Single-character Display (SCD)
2	Unload Button	4	SCD Dot

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Single-character Display (SCD)

The Single-character Display (SCD) (3 in Figure D-1 on page D-1) presents a single-character code for:

- Error conditions and informational messages
- Diagnostic or maintenance functions (while in maintenance mode only)

"Drive Error Codes" on page D-42 lists the codes for error conditions and informational messages. If multiple errors occur, the code with the highest priority (represented by the lowest number) displays first. When the error is corrected, the code with the next highest priority displays, and so on until no errors remain.

"Diagnostic and Maintenance Functions" on page D-26 lists the single-character codes that represent diagnostic or maintenance functions. To initiate a function the unit must be in maintenance mode.

The SCD is blank during normal operation.

SCD Dot

If a drive dump is present while the drive is in maintenance mode, a single red dot illuminates in the lower right corner of the SCD (4 in Figure D-1 on page D-1). To copy the dump, see "Diagnostic and Maintenance Functions" on page D-26.

The SCD Dot is ON solid if the dump is in ROM memory. The SCD Dot flashes if the dump is in FLASH memory.

The SCD Dot turns OFF when you obtain a dump (by using ITDT, a library command, or a SCSI command) or update the drive firmware.

Note: If the drive dump is stored in ROM memory (SCD Dot ON solid), the dump will be lost when you turn OFF the power or reset the drive.

Status Light

The Status Light (1 in Figure D-1 on page D-1) is a light-emitting diode (LED) that provides information about the state of the drive. The light can be green or amber, and (when lit) solid or flashing. Table D-1 lists the conditions of the Status Light and Single-character Display (SCD) and provides an explanation of what each condition means.

Table D-1. Meaning of Status Light and Single-character Display (SCD)

If the Status Light is...	and the SCD is...	Meaning
OFF	OFF	The drive has no power or is powered OFF.
Green	OFF	The drive is powered ON and in an idle state.
Flashing Green	OFF	The drive is reading from the tape, writing to the tape, rewinding the tape, locating data on the tape, loading the tape, or unloading the tape.
Flashing Green	OFF	The drive contains a cartridge during the power-ON cycle. In this case, the drive completes POST and slowly rewinds the tape (the process may take up to ten minutes). The light stops blinking and becomes solid when the drive completes the recovery and is ready for a read or write operation. To eject the cartridge, press the unload button.
Flashing Amber	Displaying Error Code	The drive is displaying error code(s) from the error code log on the SCD. For more information, see "Diagnostic and Maintenance Functions" on page D-26.

Table D-1. Meaning of Status Light and Single-character Display (SCD) (continued)

If the Status Light is...	and the SCD is...	Meaning
Amber	Red numbers, letters, or segments	During the power-on/initialization and POST (Power-On Self Test), the SCD briefly displays then becomes blank (not lit) when POST is complete and there are no POST errors. If a POST error has been detected, an error code will be displayed in the SCD and the Status Light will flash amber.
Amber	Flashing	The drive is exiting from maintenance mode. For more information, see "Diagnostic and Maintenance Functions" on page D-26.
Amber	Flashing selected function	The drive is executing the selected function while in maintenance mode.
Flashing Amber once per second	Displaying error code	An error occurred and the drive or media may require service, or it may require cleaning. Note the code on the SCD, then go to "Diagnostic and Maintenance Functions" on page D-26 to determine the action that is required.
Flashing Amber once per second	Displaying	The drive needs cleaning.
Flashing Amber twice per second	Displaying Function Code or OFF	The drive is updating firmware.[1] The SCD will display a if using an FMR cartridge. The SCD will be OFF if using the SCSI, SAS, or Fibre Channel interface. For more information, see "Methods of Updating Firmware" on page 6-25.
Flashing Amber twice per second	OFF	The drive detected an error and is performing a firmware recovery. It will reset automatically.
Flashing Amber twice per second	Flashing	The drive is requesting a cartridge to be loaded.
Flashing Amber twice per second	OFF	There is a drive dump in flash memory.
[1] Power should not be removed from the drive until the microcode update is complete. The drive indicates that the update is complete by resetting and performing POST.		

Unload Button

The Unload Button (**2** in Figure D-1 on page D-1) performs the following functions:

Table D-2. Functions that the Unload Button performs

Unload Button Function	How to Initiate the Function
Rewind the tape into the cartridge and eject the cartridge from the drive	Press the Unload Button once. The Status Light flashes green while the drive is rewinding and unloading. **Note:** During a rewind and eject operation, the drive does not accept SCSI commands from the server.
Place the drive in maintenance mode	Ensure that the drive is unloaded. Then, within two seconds, press the Unload Button three times. The drive is in maintenance mode when the Status Light becomes solid amber and appears in the SCD. **Note:** While in maintenance mode, the drive does not accept SCSI interface commands.
Scroll through the maintenance functions	While in maintenance mode, press the Unload Button once per second to increment the display characters by one. When you reach the character of the diagnostic or maintenance function that you want (see "Diagnostic and Maintenance Functions" on page D-26), press and hold the Unload Button for three seconds.
Exit maintenance mode	Press the Unload Button once per second until displays. Then press and hold the Unload Button for three seconds. Maintenance mode is exited when the Status Light becomes solid green and the SCD becomes blank.
Force a drive dump (part of the maintenance mode)	**Attention:** If the drive detects a permanent error and displays an error code, it automatically forces a drive dump (also known as a save of the firmware trace). If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn OFF the power to the drive or you may lose the dump data. Choose one of the following procedures: • If the drive is in maintenance mode (Status Light is solid amber), refer to "Diagnostic and Maintenance Functions" on page D-26. • If the drive is in operating mode (Status Light is solid or flashing green), press and hold the Unload Button for ten seconds. If captured dump data exists, the drive places it into a dump area.
Reset the drive	Press and hold the Unload Button until the drive begins the reset procedure (SCD will display random patterns and the Status Light will be amber) **Note:** If a tape cartridge is loaded in the drive the drive will unload the tape. Repeat the "Reset the drive" procedure after the tape is unloaded. The drive saves a dump of the current drive state, then reboots to allow communication. Do not cycle power as this will erase the contents of the dump.

Inserting a Tape Cartridge

To insert a tape cartridge:

1. Ensure that the drive is powered ON.
2. Ensure that the write-protect switch on the tape cartridge is properly set.

3. Grasp the cartridge so that the write-protect switch faces you (see **1** in Figure D-2).
4. Slide the cartridge into the tape load compartment.

   Note:

   a. If the cartridge is already in an ejected position and you want to reinsert it, remove the cartridge then insert it again.
   b. If the cartridge is already loaded and you cycle the power (turn it OFF, then ON), the tape will reload.

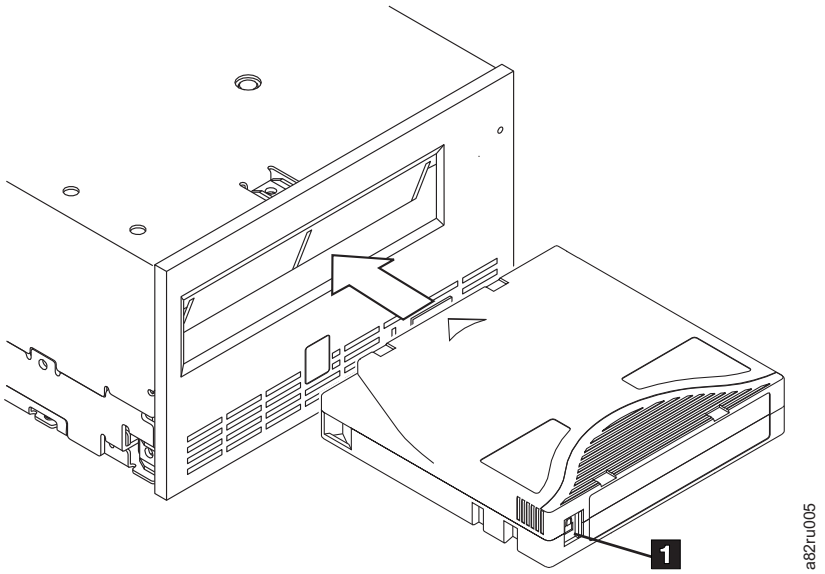

Figure D-2. Inserting a cartridge into the drive

Removing a Tape Cartridge

To remove a tape cartridge:

1. Ensure that the drive is powered ON.
2. Press the Unload Button. The drive rewinds the tape and partially ejects the cartridge. The Status Light flashes green while the tape rewinds, then goes out before the cartridge partially ejects.
3. After the cartridge partially ejects, grasp the cartridge and remove it.

Whenever you unload a tape cartridge, the drive writes any pertinent information to the cartridge memory.

Using Ultrium Media

To ensure that your IBM Ultrium Tape Drive conforms to IBM's specifications for reliability, use only IBM LTO Ultrium tape cartridges. You may use other LTO-certified data cartridges, but they may not meet the standards of reliability that are established by IBM. The IBM LTO Ultrium Data Cartridge can not be used in other IBM non-LTO Ultrium tape products.

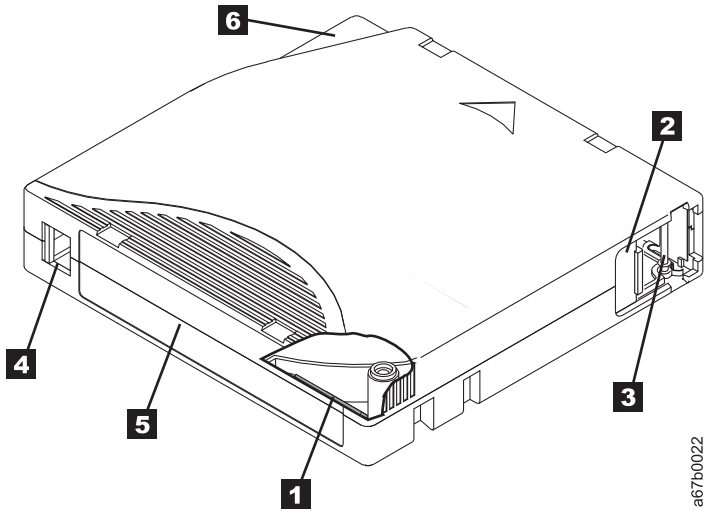

Figure D-3. The IBM LTO Ultrium Data Cartridge

1	LTO cartridge memory	a chip that contains information about the cartridge and the tape, as well as statistical information about the cartridge's use (For more information, see “Cartridge Memory Chip (LTO-CM)” on page D-7.)
2	Cartridge door	protects the tape from contamination when the cartridge is out of the drive
3	Leader Pin	The tape is attached to a leader pin, behind the cartridge door. When the cartridge is inserted into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a non-removable take-up reel. The head can then read or write data from or to the tape.
4	Write-protect Switch	prevents data from being written to the tape cartridge (For more information, see “Write-Protect Switch” on page D-7.)
5	Label area	provides a location to place a label (To obtain tape cartridges and bar code labels, see “Ordering Media Supplies” on page D-18).
6	Insertion guide	a large, notched area that prevents the cartridge from being inserted incorrectly

Types of Cartridges

Ultrium media is available in the following types:

- “Data Cartridge”
- “WORM (Write Once, Read Many) Cartridge” on page D-8
- “Cleaning Cartridge” on page D-9

Data Cartridge

All generations of IBM Ultrium data cartridges contain 1/2-inch, dual-coat, metal-particle tape. When processing tape in the cartridges, Ultrium Tape Drives use a linear, serpentine recording format.

Each generation of data cartridge is identified by case color, native data capacity, recording format and nominal cartridge life.

Data Cartridge	Case Color	Native Data Capacity	Recording Format*	Nominal Cartridge Life (load/unload cycles)
Ultrium 5	Burgundy	1500 GB (3000 GB at 2:1 compression)	Reads and writes data on 1280 tracks, sixteen tracks at a time	20,000
Ultrium 4	Green	800 GB (1600 GB at 2:1 compression)	Reads and writes data on 896 tracks, sixteen tracks at a time.	20,000
Ultrium 3	Slate Blue	400 GB (800 GB at 2:1 compression)	Reads and writes data on 704 tracks, sixteen tracks at a time	20,000
Ultrium 2	Purple	200 GB (400 GB at 2:1 compression)	Reads and writes data on 512 tracks, eight tracks at a time	10,000
Ultrium 1	Black	100 GB (200 GB at 2:1 compression)	Reads and writes data on 384 tracks, eight tracks at a time	5,000
* The first set of tracks (sixteen for Ultrium 5, 4 and 3; eight for Ultrium 2 and 1) is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the cartridge is full, or until all data is written.				

Cartridge Memory Chip (LTO-CM)

All generations of the IBM LTO Ultrium Data Cartridges include a Linear Tape-Open Cartridge Memory (LTO-CM) chip (**1** in Figure D-3 on page D-6), that contains information about the cartridge and the tape (such as the name of the manufacturer that created the tape), as well as statistical information about the cartridge's use. The LTO-CM enhances the efficiency of the cartridge. For example, the LTO-CM stores the end-of-data location which, when the next time this cartridge is inserted and the WRITE command is issued, enables the drive to quickly locate the recording area and begin recording. The LTO-CM also aids in determining the reliability of the cartridge by storing data about its age, how many times it has been loaded, and how many errors it has accumulated. Whenever a tape cartridge is unloaded, the tape drive writes any pertinent information to the cartridge memory.

The storage capacity of the LTO Generation 4 LTO-CM is 8160 bytes. LTO Generations 1, 2, and 3 have an LTO-CM capacity of 4096 bytes.

Write-Protect Switch

The position of the write-protect switch on the tape cartridge (see **4** in Figure D-3 on page D-6) determines whether you can write to the tape. If the switch is set to:

- The locked position (solid red), data cannot be written to the tape.
- The unlocked position (black void), data can be written to the tape.

If possible, use your server's application software to write-protect your cartridges (rather than manually setting the write-protect switch). This allows the server's software to identify a cartridge that no longer contains current data and is eligible to become a scratch (blank) data cartridge. Do not write-protect scratch (blank) cartridges; the tape drive will not be able to write new data to them.

If you must manually set the write-protect switch, slide it left or right to the desired position.

Capacity Scaling

To control the capacity of the cartridge (for example, to obtain a faster seek time) issue the SCSI command SET CAPACITY. For information about this command, refer to the *IBM TotalStorage Ultrium Tape Drive SCSI Reference*.

WORM (Write Once, Read Many) Cartridge

Certain records retention and data security applications require a Write Once, Read Many (WORM) method for storing data on tape. The LTO Ultrium generation 3 and 4 drives enable WORM support when a WORM tape cartridge is loaded into the drive.

Because standard read/write media are incompatible with the WORM feature, a specially formatted WORM tape cartridge (see Figure D-4) is required. Each WORM cartridge has a unique, worldwide cartridge identifier (WWCID), which comprises the unique CM chip serial number and the unique tape media serial number.

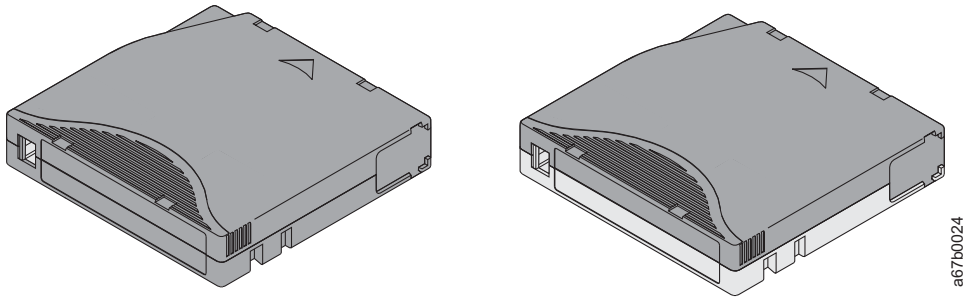

Figure D-4. Ultrium Data Cartridge on the left; WORM Cartridge on the right

Type of Cartridge	Case Color	Native Data Capacity	Recording Format*
Ultrium 5 WORM	Burgundy and silver gray	1500 GB (3000 GB at 2:1 compression)	Reads and writes data on 1280 tracks, sixteen tracks at a time
Ultrium 4 WORM	Green and silver gray	800 GB (1600 GB at 2:1 compression)	Reads and writes data on 896 tracks, sixteen tracks at a time.
Ultrium 3 WORM	Slate blue and silver gray	400 GB (800 GB at 2:1 compression)	Reads and writes data on 704 tracks, sixteen tracks at a time
* The first set of tracks (sixteen for Ultrium 5, 4 and 3; eight for Ultrium 2 and 1) is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the cartridge is full, or until all data is written.			

Data Security on WORM Media

Certain built-in security measures help ensure that the data written on a WORM cartridge does not become compromised, for example:

- The format of a WORM Tape Cartridge is unlike that of standard read/write media. This unique format prevents a drive that lacks WORM-capable firmware from writing on a WORM tape cartridge.
- When the drive senses a WORM cartridge, the firmware prohibits the changing or altering of user data already written on the tape. The firmware keeps track of the last appendable point on the tape.

WORM Media Errors

The following conditions cause WORM media errors to occur:

- Information in the servo manufacturer's word (SMW) on the tape must match information from the cartridge memory (CM) module in the cartridge. If it does not match:
  - a full-high tape drive will post a media Error Code 7 on the single-character display (SCD).
  - a library will post an error on the operator control panel
- Inserting a WORM tape cartridge into a drive that is not WORM capable causes the cartridge to be treated as an unsupported medium. The drive will report a media Error Code 7. Upgrading the drive firmware to the correct code level will resolve the problem.

Requirements for WORM Capability

To add WORM capability to your LTO Ultrium generation 3 or generation 4 drive(s), drive firmware must be at the correct code level, and you must use either Ultrium 3 400 GB WORM tape cartridges or Ultrium 4 800 GB WORM tape cartridges (see "Ordering Media Supplies" on page D-18).

Cleaning Cartridge

With each library, a specially labeled IBM LTO Ultrium Cleaning Cartridge is supplied to clean the drive head. The drive itself determines when a head needs to be cleaned. To clean the head, insert the cleaning cartridge into the tape load compartment of the drive or the Input/Output (I/O) Station of the library. The cleaning is performed automatically. When the cleaning is finished, the cartridge is ejected.

Note: The drive will automatically eject an expired cleaning cartridge.

IBM Cleaning Cartridges are valid for 50 uses. The cartridge's LTO-CM chip tracks the number of times that the cartridge is used.

Cartridge Compatibility

The following table demonstrates the Ultrium cartridge compatibility with the Ultrium tape drives.

Table D-3. Ultrium cartridge compatibility with Ultrium tape drives

IBM Ultrium Tape Drive	IBM LTO Ultrium Data Cartridges				
	1600 GB (Ultrium 5)	**800 GB (Ultrium 4)**	**400 GB (Ultrium 3)**	**200GB (Ultrium 2)**	**100GB (Ultrium 1)**
Ultrium 5	Read/Write	Read/Write	Read/Write		
Ultrium 4		Read/Write	Read/Write	Read only	
Ultrium 3			Read/Write	Read/Write	Read only
Ultrium 2				Read/Write	Read/Write
Ultrium 1					Read/Write

Bar Code Labels

A bar code label contains:

- A volume serial number (VOLSER) that is human-readable

- A bar code that the library can read

Note: The tape drive does not require bar code labels, but you may choose to use labels for tape cartridge identification purposes.

Table D-4. Bar code label requirements for Ultrium tape drives and libraries

Ultrium Tape Drive/Library	Bar Code Label Requirements
3573	Required
3576	Required
3580	Not required
3581	Required with optional Bar Code Reader
3582	Required
3583	Required
3584	Required

When read by a library's bar code reader, the bar code identifies the cartridge's VOLSER to the library. The bar code also tells the library whether the cartridge is a data cartridge, WORM cartridge or cleaning cartridge. In addition, the bar code includes the two-character media-type identifier Lx, where x equals 1, 2, 3, 4, T or U. Figure D-5 on page D-11 shows a sample bar code label for the LTO Ultrium Tape Cartridge.

Table D-5. Cartridges and VOLSERs

Cartridges	VOLSER
Ultrium 5 Data Cartridge	xxxxxxL5
Ultrium 5 WORM Cartridge	xxxxxxLV
Ultrium 4 Data Cartridge	xxxxxxL4
Ultrium 4 WORM Cartridge	xxxxxxLU
Ultrium 3 Data Cartridge*	xxxxxxL3
Ultrium 3 WORM Cartridge	xxxxxxLT
Ultrium 2 Data Cartridge	xxxxxxL2
Ultrium 1 Data Cartridge (READ ONLY)	xxxxxxL1
IBM LTO Ultrium Cleaning Cartridge	CLNxxxLx
*An Ultrium 3 Tape Drive must have a minimum firmware level of 54xx for it to be compatible with the WORM cartridge.	

Tape cartridges can be ordered with the labels included or with custom labels. To order tape cartridges and bar code labels, . The bar code for usage in IBM tape libraries must meet predefined specifications. They include (but are not limited to):

- Eight uppercase alphanumeric characters, where the last two characters must be L5, L4, L3, L2, L1, LT, or LU
- Label and printing to be non-glossy
- Nominal narrow line or space width of 0.423 mm (0.017 in.)
- Wide to narrow ratio of 2.75:1
- Minimum bar length of 11.1 mm (0.44 in.)
- The effective tape cartridge barcode label length, including any media ID, may be limited to a maximum of 12 characters. A barcode label with more than 12

characters may not be printable according to the Code 39 label specifications for the tape cartridge area to which the label is attached.

To determine the complete specifications of the bar code and the bar code label, visit the web at **http://www.ibm.com/storage/lto** (select **LTO Support**), or contact your IBM Sales Representative.

When attaching a bar code label to a tape cartridge, place the label only in the recessed label area (see **4** in Figure D-3 on page D-6). A label that extends outside of the recessed area can cause loading problems in the drive.

Attention: Do not place any type of mark on the white space at either end of the bar code. A mark in this area may prevent the library from reading the label.

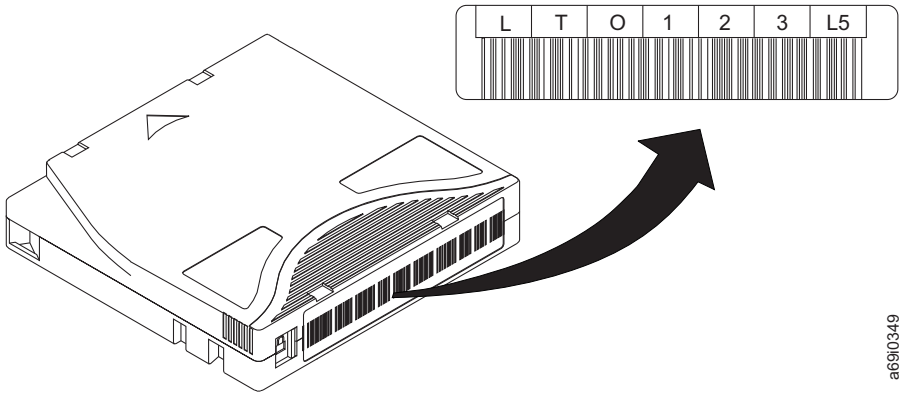

Figure D-5. Sample bar code label on the LTO Ultrium 5 Tape Cartridge. The volume serial number (LTO123), cartridge type (L5), and bar code are printed on the label.

Guidelines for Using Bar Code Labels

Apply the following guidelines whenever using bar code labels:

- Use only IBM-approved bar code labels on cartridges to be used in an IBM tape library.
- Do not reuse a label or reapply a used label over an existing label.
- Before you apply a new label, remove the old label by slowly pulling it at a right angle to the cartridge case.
- Use peel-clean labels that do not leave a residue after being removed. If there is glue residue on the cartridge, remove it by gently rubbing it with your finger. Do not use a sharp object, water, or a chemical to clean the label area.
- Examine the label before applying it to the cartridge. Do not use the label if it has voids or smears in the printed characters or bar code (a library's inventory operation will take much longer if the bar code label is not readable).
- Remove the label from the label sheet carefully. Do not stretch the label or cause the edges to curl.
- Position the label within the recessed label area (see **5** in Figure D-3 on page D-6).
- With light finger pressure, smooth the label so that no wrinkles or bubbles exist on its surface.
- Verify that the label is smooth and parallel, and has no roll-up or roll-over. The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, or smudges.

- Do not place other machine-readable labels on other surfaces of the cartridge. They may interfere with the ability of the drive to load the cartridge.

Unlabeled Media Detection

At bootup and other times the library performs an inventory of all slots and media. If a slot contains media with an unreadable barcode label (for example, the label is missing, torn, or marked up), the scanner cannot identify it, so the library normally reports the slot as empty.

With the Unlabeled Media Detection feature, you can configure the library to detect and report which slots contain media with unreadable barcodes. Since cartridges with unreadable barcodes will not work for some library functions, knowing which labels are bad enables you to replace them with good ones as soon as possible.

When you enable Unlabeled Media Detection, the calibration sensor re-scans slots identified as empty in the inventory to see if a cartridge is physically in the slot. If so, the library reports the cartridge as having an unreadable barcode.

Note: The library always re-scans “empty” slots in the top and bottom rows of the library, even if you don't enable the Unlabeled Media Detection feature. This is because occasionally a small or poorly placed label cannot be read by the barcode scanner in those two rows. The calibration sensor re-scans the bottom row, and the picker physically checks the top row because the calibration sensor cannot reach it.

"Bottom row" here means the bottommost available row as indicated in the library configuration report.

This feature is disabled by default. When enabled, the following occurs:

- The re-scan may take up to several minutes to complete.
- The library configuration report indicates media with unreadable barcodes by displaying a red triangle in the corner of the slot.
- The library user interface lists

  `No_Label`

  as the barcode for all cartridges with unreadable labels.
- The library posts a RAS ticket (T143) when an unreadable barcode label is detected. As long as that ticket remains open, no more T143 tickets will be issued, even if more unreadable barcode labels are found.
- An unreadable barcode label is re-scanned every time the cartridge moves to a new location to check if it is readable in the new location.

To enable the library to report unreadable barcodes:

1. Access the System Settings page as follows:
   - On the Operator Panel, press **Tools** > **System Settings** > **Unlabeled Detection**.
   - From the Web User Interface: **Manage Library** > **Settings** > **Media Detection** .
2. Select one of the following from the **Unlabeled Media Detection** list:

Selection	Action
None (default) • On the Operator Panel, uncheck the **Unlabeled Media Detection** checkbox. • On the Web User Interface, uncheck the **Enable Unlabeled Media Detection** checkbox.	Performs the standard inventory only. Includes a re-scan of the top and bottom rows only.
I/O • On the Operator Panel, select the **Unlabeled Media Detection** checkbox, then select **I/O**. • On the Web User Interface, select the **Enable Unlabeled Media Detection** checkox, then select **I/O**	Re-scans all slots in the I/E station that were identified as empty in the standard inventory. If media is detected, it is assumed to have an unreadable barcode.
All • On the Operator Panel, select the **Unlabeled Media Detection** checkbox, then select **All**. • On the Web User Interface, select the **Enable Unlabeled Media Detection** checkox, then select **All**.	Re-scans all slots in the library that were identified as empty in the standard inventory. If media is detected, it is assumed to have an unreadable barcode.

3. On the Operator Panel, click **Apply** or for the web user interface, click **Submit Changes**.

Importing Unassigned Media

Media is considered unassigned when it is placed into the !/O station and not assigned to a partition. When you place cartridges into the !/O station and close the door, the local Operator Panel displays a window asking you to assign the cartridge(s) to a partition. If you cancel out of the screen and do not assign the media to any partition, the cartridges remain unassigned. Alternatively, if you disable manual cartridge assignment (Operator Panel: **Tools** > **System Settings**), the screen asking you to assign cartridges to a partition does not appear and the cartridges in the !/O station remain unassigned.

From the web client you can import unassigned media into the library only if manual cartridge assignment is disabled. This applies to both regular media and cleaning media.

Note: Whether manual cartridge assignment is enabled or disabled, if there are multiple unassigned tape cartridges in the !/O station and you only select some of them to import into the library, they will ALL be assigned to the first partition that you select. However, only the ones you select for import will actually be moved into the library storage slots.

Differences in what you can see and do depending on manual cartridge assignment status:

Table D-6. Manual Cartridge Assignment Status

Manual Cartridge Assignment	Cartridge Assignment in !/O Station	Importing Unassigned Media	Library Configuration Report
ON (default)	You are asked to assign cartridges to a partition immediately upon placing them in the !/O station. You may "cancel" out of this window without assigning them to a partition.	From Operator Panel: **NO** From Web client: **NO**	Unassigned cartridges are not visible.
OFF	You are not asked to assign cartridges to a partition and the cartridges remain unassigned.	From Operator Panel: **YES** From Web client: **YES**	Unassigned cartridges are visible.

Handling Cartridges

Attention: Do not insert a damaged tape cartridge into the drive. A damaged cartridge can interfere with the reliability of a drive and may void the warranties of the drive and the cartridge. Before inserting a tape cartridge, inspect the cartridge case, cartridge door, and write-protect switch for breaks.

Incorrect handling or an incorrect environment can damage cartridges or their magnetic tape. To avoid damage to your tape cartridges and to ensure the continued high reliability of your IBM LTO Ultrium Tape Drives, use the following guidelines.

Provide Training

- Post procedures that describe proper media handling in places where people gather.
- Ensure that anyone who handles tape has been properly trained in handling and shipping procedures. This includes operators, users, programmers, archival services, and shipping personnel.
- Ensure that any service or contract personnel who perform archiving are properly trained in media-handling procedures.
- Include media-handling procedures as part of any services contract.
- Define and make personnel aware of data recovery procedures.

Provide Proper Acclimation and Environmental Conditions

- Before using a cartridge, let it acclimate to the normal operating environment for 1 hour. If condensation is visible on the cartridge, wait an additional hour.
- Ensure that all surfaces of a cartridge are dry before inserting it.
- Do not expose the cartridge to moisture or direct sunlight.
- Do not expose recorded or blank cartridges to stray magnetic fields of greater than 100 oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure can cause the loss of recorded data or make the blank cartridge unusable.

- Maintain the conditions that are described in Table D-7 on page D-17.

Perform a Thorough Inspection

After purchasing a cartridge and before using it, perform the following steps:

- Inspect the cartridge's packaging to determine potential rough handling.
- When inspecting a cartridge, open only the cartridge door. Do not open any other part of the cartridge case. The upper and lower parts of the case are held together with screws; separating them destroys the usefulness of the cartridge.
- Inspect the cartridge for damage before using or storing it.
- Inspect the rear of the cartridge (the part that loads first into the tape load compartment) and ensure that there are no gaps in the seam of the cartridge case (see **1** in Figure D-6 and **4** in Figure D-10 on page D-21). If there are gaps in the seam (see Figure D-6), the leader pin may be dislodged.

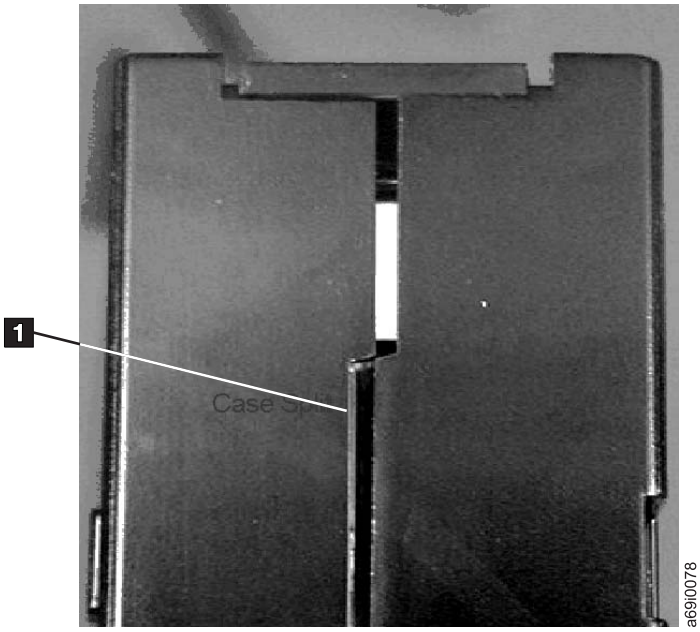

Figure D-6. Checking for gaps in the seams of a cartridge

- Check that the leader pin is properly seated (see **2** in Figure D-10 on page D-21).
- If you suspect that the cartridge has been mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.
- Review handling and shipping procedures.

Handle the Cartridge Carefully

- Do not drop the cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly seated in the pin-retaining spring clips (see **2** in Figure D-9 on page D-21). If the leader pin has become dislodged, go to "Repositioning a Leader Pin" on page D-20.

- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape's surface or edges, which may interfere with read or write reliability. Pulling on tape that is outside the cartridge can damage the tape and the brake mechanism in the cartridge.
- If cartridges must be stacked horizontally for moving and handling, do not stack cartridges more than five high.
- Do not degauss a cartridge that you intend to reuse. Degaussing makes the tape unusable.
- For external long-term vaulted storage, store cartridges in a vertical orientation.

Ensure Proper Packaging

- When shipping a cartridge, use the original or better packaging.
- Always ship or store a cartridge in a jewel case.
- Use only a recommended shipping container that securely holds the cartridge in its jewel case during transportation. Ultrium Turtlecases (by Perm-A-Store) have been tested and found to be satisfactory . They are available at **http://www.turtlecase.com**.

Figure D-7. Tape cartridges in a Turtlecase

- Never ship a cartridge in a commercial shipping envelope. Always place it in a box or package.
- If you ship the cartridge in a cardboard box or a box of a sturdy material, ensure the following:
  - Place the cartridge in polyethylene plastic wrap or bags to protect it from dust, moisture, and other contaminants.
  - Pack the cartridge snugly; do not allow it to move around.
  - Double-box the cartridge (place it inside a box, then place that box inside the shipping box) and add padding between the two boxes.

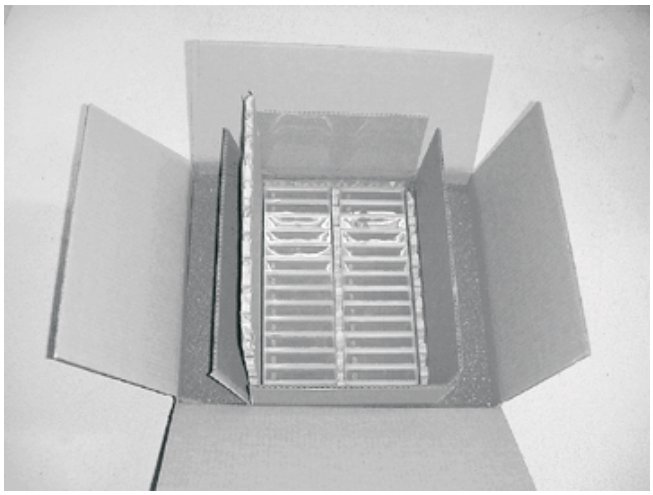

Figure D-8. Double-boxing tape cartridges for shipping

Environmental and Shipping Specifications for Tape Cartridges

Before you use a tape cartridge, acclimate it to the operating environment to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the cartridge was exposed).

The best storage container for the cartridges (until they are opened) is the original shipping container. The plastic wrapping prevents dirt from accumulating on the cartridges and partially protects them from humidity changes.

When you ship a cartridge, place it in its jewel case or in a sealed, moisture-proof bag to protect it from moisture, contaminants, and physical damage. Ship the cartridge in a shipping container that has enough packing material to cushion the cartridge and prevent it from moving within the container.

Table D-7. Environment for operating, storing, and shipping the LTO Ultrium Tape Cartridge

	Environmental Specifications			
Environmental Factor	**Operating**	**Operational Storage**[1]	**Archival Storage**[2]	**Shipping**
Temperature	10 to 45°C(50 to 113°F)	16 to 32°C(61 to 90°F)	16 to 25°C(61 to 77°F)	-23 to 49°C(-9 to 120°F)
Relative humidity (non-condensing)	10 to 80%	20 to 80%	20 to 50%	5 to 80%
Maximum wet bulb temperature	26°C(79°F)	26°C(79°F)	26°C(79°F)	26°C(79°F)

Note:

1. The short term or operational storage environment is for storage durations of up to six months.
2. The long term or archival storage environment is for durations of six months up to ten years.
3. Local tape temperature in excess of 52 degC may cause permanent tape damage.

Disposing of Tape Cartridges

Under the current rules of the U.S. Environmental Protection Agency (EPA), regulation 40CFR261, the LTO Ultrium Tape Cartridge is classified as

non-hazardous waste. As such, it may be disposed of in the same way as normal office trash. These regulations are amended from time to time, and you should review them at the time of disposal.

If your local, state, country (non-U.S.A.), or regional regulations are more restrictive than EPA 40CFR261, you must review them before you dispose of a cartridge. Contact your account representative for information about the materials that are in the cartridge.

If a tape cartridge must be disposed of in a secure manner, you can erase the data on the cartridge by using a high-energy ac degausser (use a minimum of 4000 oersted peak field over the entire space that the cartridge occupies). The tape should make two passes through the field at 90 degree orientation change for each pass to achieve complete erasure. Some commercial degaussers have two magnetic field regions offset 90 degrees from each other to accomplish complete erasure in one pass for higher throughput. Degaussing makes the cartridge unusable.

If you burn the cartridge and tape, ensure that the incineration complies with all applicable regulations.

Ordering Media Supplies

To find the closest IBM-authorized distributor, visit the web at `http://www.ibm.com/storage/media` or call 1-888-IBM-MEDIA.

Table D-8. Media supplies

Item Type	Description	Quantity	Order by Machine Type/Model from IBM Sales Representative or authorized IBM Business Partner	Order by Part Number (P/N) from an IBM Authorized Distributor
Data Cartridges (with labels) (Specify the VOLSER characters that you want.)	Ultrium 5	20-PACK	MachineType 3589 Model 014	46X1951 (color label) 46X1953 (black and white label)
	Ultrium 4	20-PACK	Machine Type 3589 Model 010	95P4443 (color label) 95P4445 (black and white label)
	Ultrium 3	1	Machine Type 3589 Model 008	96P1470 (color label) 96P1471 (black and white label)
	Ultrium 2	1	Machine Type 3589 Model 006	
Data Cartridges (without labels) Order VOLSER labels separately (see "Ordering Bar Code Labels" on page D-19).	Ultrium 5	20-PACK	Machine Type 3589 Model 015	46X1960
	Ultrium 4	20-PACK	Machine Type 3589 Model 011	95P4447
	Ultrium 3	1	Machine Type 3589 Model 009	24R1922
	Ultrium 2	1	Machine Type 3589 Model 007	
	Ultrium 1	20-PACK	Machine Type 3589 Model 003	08L9120

Table D-8. Media supplies (continued)

Item Type	Description	Quantity	Order by Machine Type/Model from IBM Sales Representative or authorized IBM Business Partner	Order by Part Number (P/N) from an IBM Authorized Distributor
WORM Cartridges (with labels) (Specify the VOLSER characters that you want.)	Ultrium 5	20-PACK	Machine Type 3589 Model 034	46X1963 (color label) 46X1965 (black and white label)
	Ultrium 4	20-PACK	Machine Type 3589 Model 032	95P4457 (color label) 95P4459 (black and white label)
	Ultrium 3	20-PACK	Machine Type 3589 Model 028 WORM cartridges labeled with starting volume serial information and, optionally, packed in individual jewel cases.	
WORM Cartridges (without labels) Order VOLSER labels separately (see "Ordering Bar Code Labels").	Ultrium 5	20-PACK	Machine Type 3589 Model 035	46X1972
	Utrium 4	20-PACK	Machine Type 3589 Model 033	95P4461
	Ultrium 3	20-PACK	Machine Type 3589 Model 029 Feature Code 2920 WORM cartridges packed in individual jewel cases with unattached blank labels.	
Cleaning Cartridge (with label)	Universal Cleaning Cartridge	5-PACK	Machine Type 3589 Model 004 Feature Code 4005	35L2086
Repair Tools	Leader Pin Reattachment Kit	1	not available in this sales channel	08L9129
	Manual Rewind Tool	1	not available in this sales channel	08L9130

Ordering Bar Code Labels

The Ultrium Tape Drives do not require cartridge bar code labels. However, if you use your data cartridges or cleaning cartridges in an IBM tape library product, you may need cartridge bar code labels if your tape library product requires them (see "Bar Code Labels" on page D-9.

You can order bar code labels with your data and cleaning cartridges, or you can order them directly from the authorized label suppliers listed in the table below.

Table D-9. Authorized suppliers of custom bar code labels

In America	In Europe and Asia
Tri-Optic Broomfield, CO U. S. A. Telephone: 888-438-8362 http://www.tri-optic.com	EDP Europe, Ltd. U. K. Telephone: 44 (0) 1245-322380 http://www.edpeurope.com/media_labelling.htm
Dataware Houston, TX U. S. A. Telephone: 800-426-4844 http://www.datawarelabels.com/	Dataware Labels Europe Germany Telephone: 49 8062-9455 http://www.datawarelabels.com/
NetC Fairfield, CT U. S. A. Telephone: 203-372-6382 http://www.netcllc.com/	NetC Europe Ltd U. K. Telephone: 44 (0) 1823 49 1439 http://www.netclabels.co.uk
	NetC Asia Pacific Pty Ltd Australia Telephone: 61 (0) 2 4573 6556 http://www.netclabels.com.uk

Repairing a Cartridge

Attention: Use a repaired tape cartridge only to recover data and move it to another cartridge. Continued use of a repaired cartridge may void the warranties of the drive and the cartridge.

If the leader pin in your cartridge becomes dislodged from its pin-retaining spring clips or detaches from the tape, you must use the IBM® Leader Pin Reattachment Kit (part number 08L9129) to reposition or reattach it. (Do not reattach the pin if you must remove more than seven meters (23 feet) of leader tape.) The sections that follow describe each procedure.

- "Repositioning a Leader Pin"
- "Reattaching a Leader Pin" on page D-22

Repositioning a Leader Pin

To place the leader pin in its proper position, you will need the following tools:

- Plastic or blunt-end tweezers
- Cartridge manual rewind tool (from Leader Pin Reattachment Kit, part number 08L9129)

A leader pin that is improperly seated inside a cartridge can interfere with the operation of the drive. Figure D-9 on page D-21 shows a leader pin in the incorrect **1** and correct **2** positions.

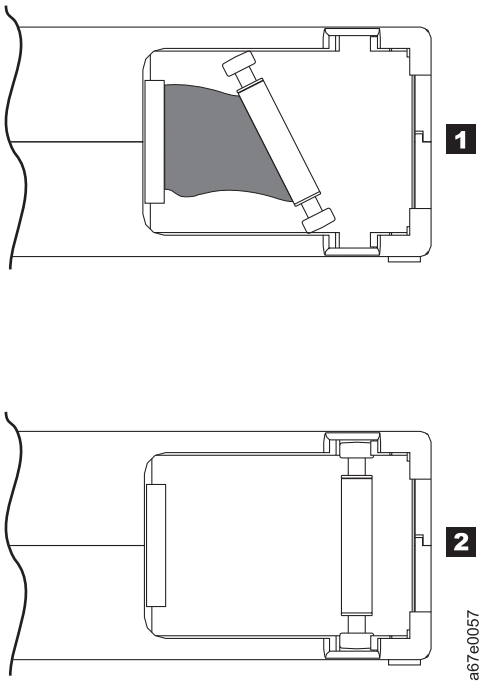

Figure D-9. Leader pin in the incorrect and correct positions. The cartridge door is open and the leader pin is visible inside the cartridge.

To reposition the leader pin, refer to Figure D-10 and perform the steps below.

1. Slide open the cartridge door (**1**) and locate the leader pin (**2**)
   Note: If necessary, shake the cartridge gently to roll the pin toward the door.
2. With plastic or blunt-end tweezers, grasp the leader pin and position it in the pin-retaining spring clips (**3**).
3. Press the leader pin gently into the clips until it snaps into place and is firmly seated.
4. Close the cartridge door.
5. Ensure that there are no gaps in the seam of the cartridge

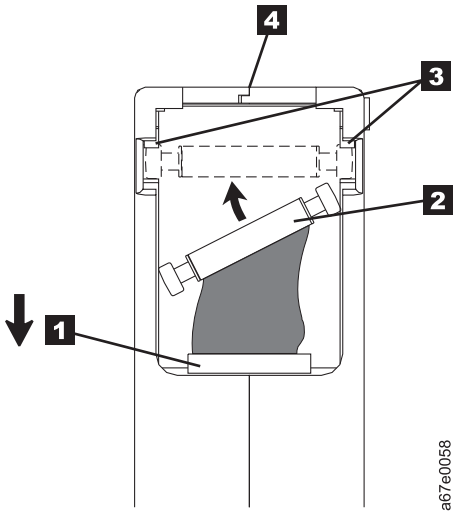

Figure D-10. Placing the dislodged leader pin into the correct position

To rewind the tape, refer to Figure D-11 and perform the steps below.

1. Insert the cartridge manual rewind tool (**1**) into the cartridge's hub (**2**) and turn it clockwise until the tape becomes taut.
2. Remove the rewind tool by pulling it away from the cartridge.
3. If you suspect that the cartridge has been mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.

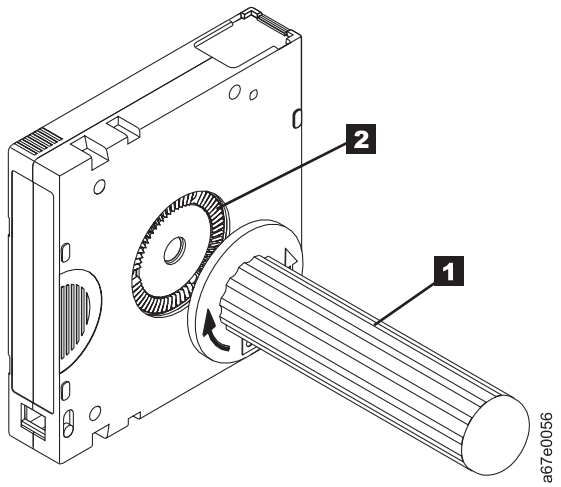

Figure D-11. Rewinding the tape into the cartridge

Reattaching a Leader Pin

The first meter of tape in a cartridge is leader tape. Once the leader tape has been removed there is a possibility of tape breakage. After reattaching the leader pin, transfer data from the defective tape cartridge. **Do not reuse the defective tape cartridge**.

The Leader Pin Reattachment Kit contains three parts:

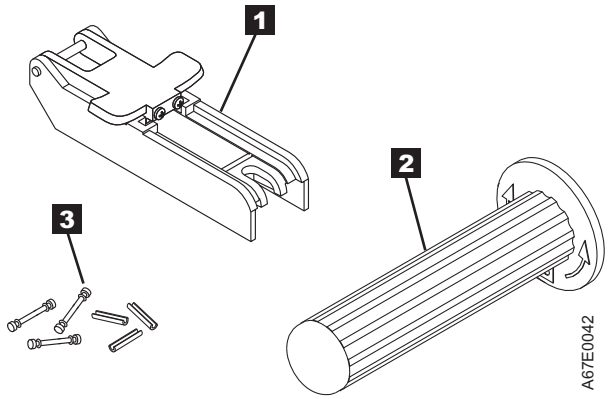

Figure D-12. Leader Pin Reattachment Kit

- **Leader pin attach tool** (**1**). A plastic brace that holds the cartridge door open.
- **Cartridge manual rewind tool** (**2**). A device that fits into the cartridge's hub and lets you wind the tape into and out of the cartridge.
- **Pin supplies** (**3**). Leader pins and C-clips.

Attention:

- Use only the IBM Leader Pin Reattachment Kit to reattach the leader pin to the tape. Other methods of reattaching the pin will damage the tape, the drive, or both.
- Use this procedure on your tape cartridge only when the leader pin detaches from the magnetic tape and you must copy the cartridge's data onto another cartridge. Destroy the damaged cartridge after you copy the data. This procedure may affect the performance of the leader pin during threading and unloading operations.
- Touch only the end of the tape. Touching the tape in an area other than the end can damage the tape's surface or edges, which may interfere with read or write reliability.

To reattach a leader pin by using the IBM Leader Pin Reattachment Kit, refer to Figure D-13 and perform the steps below.

1. Attach the leader pin attach tool (**1**) to the cartridge (**2**) so that the tool's hook (**3**) latches into the cartridge's door (**4**).
2. Pull the tool back to hold the door open, then slide the tool onto the cartridge. Open the tool's pivot arm (**5**).

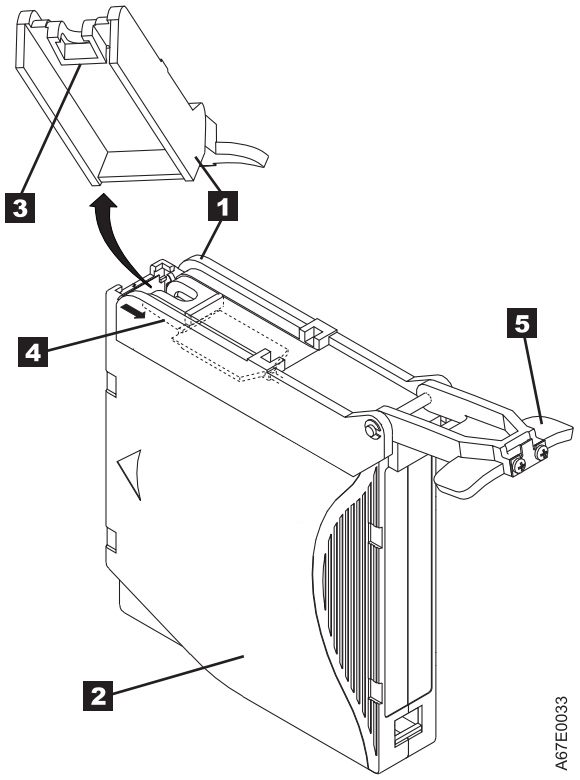

Figure D-13. Attaching the leader pin attach tool to the cartridge. To hold the cartridge door open, hook the tool into the door and pull the tool back.

To find the end of the tape inside the cartridge, refer to Figure D-14 on page D-24 and perform the steps below.

1. Attach the cartridge manual rewind tool (**1**) to the cartridge's hub (**2**) by fitting the tool's teeth between the teeth of the hub. Turn the tool clockwise

until you see the end of the tape inside the cartridge. Then, slowly turn the rewind tool counterclockwise to bring the tape edge toward the cartridge door (3).

2. Continue to turn the rewind tool counterclockwise until approximately 13 cm (5 in.) of tape hangs from the cartridge door. If necessary, grasp the tape and pull gently to unwind it from the cartridge.
3. Remove the rewind tool by pulling it away from the cartridge. Set the tool and the cartridge aside.

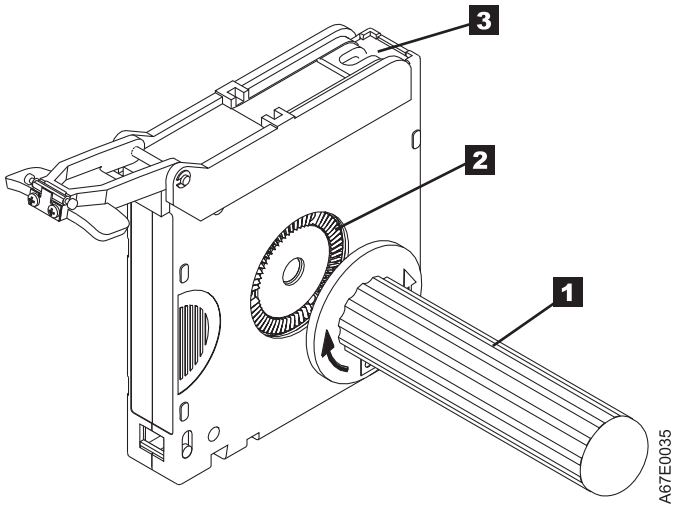

Figure D-14. Winding the tape out of the cartridge. Turn the cartridge manual rewind tool clockwise to see the end of the tape, then turn it counterclockwise to bring the tape to the cartridge door.

To remove the C-clip from the leader pin, refer to Figure D-15 and perform the steps below.

1. On the leader pin (1), locate the open side of the C-clip (2). The C-clip is a small black part that secures the tape (3) to the pin.
2. Remove the C-clip from the leader pin by using your fingers to push the clip away from the pin. Set the pin aside and discard the clip.

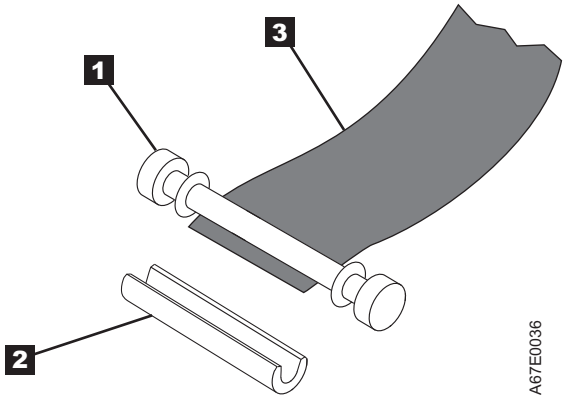

Figure D-15. Removing the C-clip from the leader pin. Use your fingers to push the C-clip from the leader pin.

To attach the leader pin to the tape, refer to Figure D-16 on page D-26 and perform the steps below.

1. Position the tape in the alignment groove of the leader pin attach tool (1).

2. Place a new C-clip into the retention groove (2) on the leader pin attachment tool and make sure that the clip's open side faces up.
3. Place the leader pin that was removed earlier into the cavity (3) of the leader pin attach tool.

   Attention: To prevent the leader pin from rolling into the cartridge, in the following step use care when folding the tape over the pin.
4. Fold the tape over the leader pin and hold it with your fingers.

   Note: Use care to ensure that the tape is centered over the leader pin. Failure to properly center the tape on the pin will cause the repaired cartridge to fail. When the tape is properly centered, a 0.25 mm (0.01 in.) gap exists on both sides of the pin.
5. Close the pivot arm (4) of the leader pin attach tool by swinging it over the leader pin so that the C-clip snaps onto the pin and the tape.
6. Swing the pivot arm open and trim the excess tape (5) so that it is flush with the reattached leader pin (6).
7. Use your fingers to remove the leader pin from the cavity (3) in the leader pin attach tool.
8. Use the cartridge manual rewind tool to wind the tape back into the cartridge (wind the tape clockwise). Ensure that the leader pin is latched by the pin-retaining spring clips on each end of the leader pin.
9. Remove the rewind tool.
10. Remove the leader pin attach tool by lifting its end up and away from the cartridge.

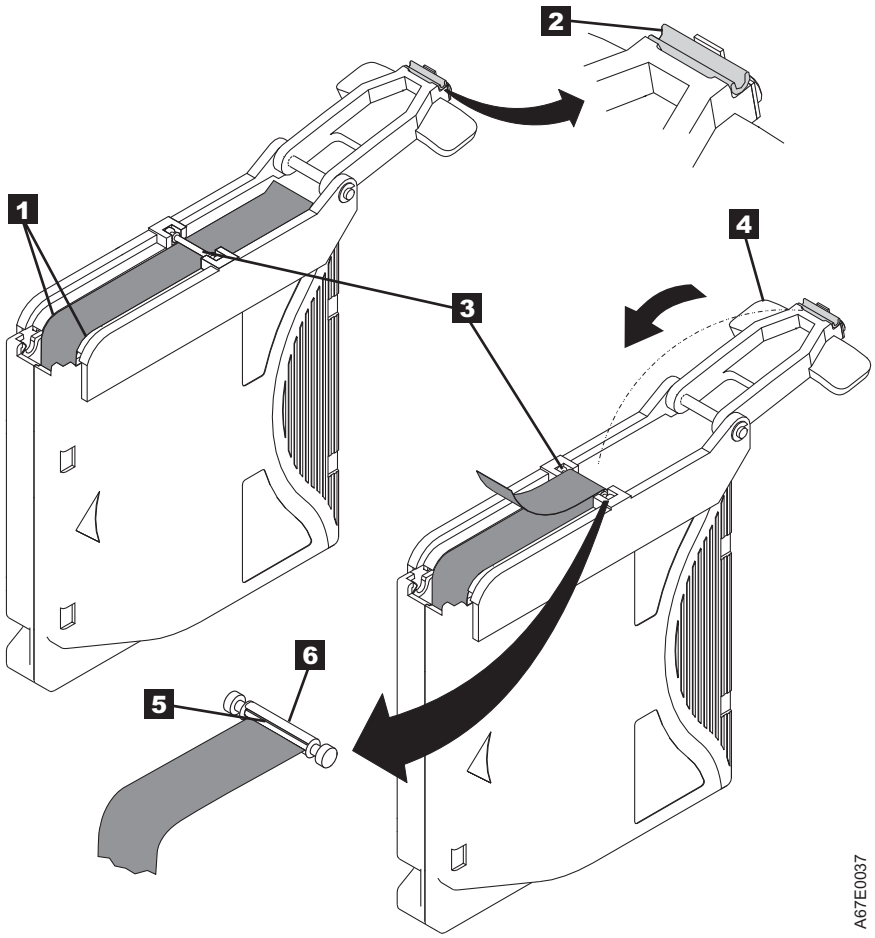

Figure D-16. Attaching the leader pin to the tape

Diagnostic and Maintenance Functions

The drive can:

- Run diagnostics
- Test write and read functions
- Test a suspect tape cartridge
- Update its own firmware
- Perform other diagnostic and maintenance functions

The drive must be in maintenance mode to perform these functions.

Attention: Maintenance functions cannot be performed concurrently with read or write operations. While in maintenance mode, the tape drive does not accept SCSI commands from the server. The tape drive does accept LDI or RS-422 commands.

Table D-10 on page D-27 describes each diagnostic and maintenance function that the drive can perform, gives the function code which appears on the Single-character Display (SCD), and directs you to the instructions for performing the function. It is recommended that you use a customer-supplied scratch (blank) data cartridge for diagnostic testing.

Table D-10. Diagnostic and maintenance functions

Function Code	Diagnostic or Maintenance Function	Instructions Location
	Exit Maintenance Mode: Causes the drive to become available for reading and writing data.	"Function Code 0: Maintenance Mode" on page D-29
	Run Drive Diagnostics: Runs tests to determine whether the drive can properly load and unload cartridges, and read and write data.	"Function Code 1: Run Drive Diagnostics" on page D-29
	Update Tape Drive Firmware from FMR Tape: Loads updated firmware from a field microcode replacement (FMR) tape.	"Function Code 2: Update Drive Firmware from FMR Tape" on page D-30
	Create FMR Tape: Copies its field microcode replacement (FMR) data to a customer-supplied scratch (blank) data cartridge.	"Function Code 3: Create FMR Tape" on page D-31
	Force a Drive Dump: Performs a dump of data (also known as saving a microcode trace).	"Function Code 4: Force a Drive Dump" on page D-31
	Copy Drive Dump: Copies data from a drive dump (captured by using Function Code 4) to the beginning of a customer-supplied scratch (blank) data cartridge, copies a drive dump to flash memory, or erases a dump from flash memory.	"Function Code 5: Copy Drive Dump" on page D-32
	Run Host Interface Wrap Test: Performs a check of the circuitry from and to the connector.	"Function Code 6: Run Host Interface Wrap Test" on page D-33
	Run RS-422 Wrap Test: This test causes the drive to perform a check of the circuitry and connector for the RS-422 interface.	"Function Code 7: Run RS-422 Wrap Test" on page D-34
	Unmake FMR Tape: Erases the FMR data on a customer-supplied scratch (blank) data cartridge and rewrite the cartridge memory on the tape. This turns the cartridge into a valid customer-supplied scratch data cartridge.	"Function Code 8: Unmake FMR Tape" on page D-34
	Display Error Code Log: Displays the last 10 error codes, one at a time (the codes are ordered; the most recent is presented first and the oldest (tenth) is presented last).	"Function Code 9: Display Error Code Log" on page D-35
	Clear Error Code Log: Erases the contents of the error code log.	"Function Code A: Clear Error Code Log" on page D-35
	Insert Cartridge into Tape Drive: This function cannot be selected by itself, but is a part of other maintenance functions (such as Run Tape Drive Diagnostics and Create FMR Tape) that require a tape cartridge to be loaded.	"Function Code C: Insert Cartridge into Tape Drive" on page D-36
	Test Cartridge & Media: Performs tests to ensure that a suspect cartridge and its magnetic tape are acceptable.	"Function Code E: Test Cartridge & Media" on page D-36
	Write Performance Test: Performs tests to ensure that the drive can read from and write to tape.	"Function Code F: Write Performance Test" on page D-37
	Test Head: Performs tests to ensure that the tape drive's head and tape-carriage mechanics are working correctly.	"Function Code H: Test Head" on page D-38
	Fast Read/Write Test: Performs tests to ensure that the drive can read from and write to tape.	"Function Code J: Fast Read/Write Test" on page D-39
	Load/Unload Test: Tests the drive's ability to load and unload a tape cartridge.	"Function Code L: Load/Unload Test" on page D-40

Table D-10. Diagnostic and maintenance functions (continued)

Function Code	Diagnostic or Maintenance Function	Instructions Location
P	**Enable Post Error Reporting:** When selected, deferred-check conditions are reported to the host.	"Function Code P: Post Error Reporting Enabled" on page D-41
U	**Disable Post Error Reporting:** When selected, deferred-check conditions are NOT reported to the host.	"Function Code U: Post Error Reporting Disabled" on page D-41

Entering Maintenance Mode

The drive must be in maintenance mode to run drive diagnostics or maintenance functions. To place the unit in maintenance mode:

1. Make sure that no cartridge is in the drive.
2. Press the Unload Button three times within two seconds. 0 appears in the Single-character Display (SCD), and the Status Light turns amber.

   Note: If a cartridge is in the tape drive, it will eject the first time that you press the Unload Button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, perform the preceding step.

Maintenance functions cannot be performed concurrently with read or write operations. While in maintenance mode, the drive does not receive SCSI commands from the server.

Exiting Maintenance Mode

The drive must be in Function Code 0 in order to exit Maintenance Mode.

To exit Maintenance Mode:

1. Press the Unload Button once per second until 0 appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second util the code appears.)
2. Press and hold the Unload Button for three or more seconds, then release it.

To exit Maintenance Mode when an error is displayed:

1. Press the Unload Button three times within two seconds to clear the error code and return to Function Code 0.
2. Press and hold the Unload Button for three or more seconds, then release it.

Note: The drive will exit Maintenance Mode automatically when:

- it completes a maintenance function
- if there is an error code for anything other than a hardware problem
- if no action has occurred for 10 minutes

The drive will not exit Maintenance Mode automatically if there is an error code displayed that indicates there is a hardware problem.

Function Code 0: Maintenance Mode

Function Code makes the drive available for running drive diagnostics or maintenance functions, or exiting from Maintenance Mode.

1. Place the drive in Maintenance Mode. For instructions, see"Entering Maintenance Mode" on page D-28.
2. To exit Maintenance Mode, see "Exiting Maintenance Mode" on page D-28.

The drive exits Maintenance Mode automatically after it completes a maintenance function or after 10 minutes if no action has occurred.

Function Code 1: Run Drive Diagnostics

Approximate Run Time = 20 minutes per loop

Total Number of Loops = 10

Function Code runs tests that determine whether the drive can properly load and unload cartridges and read and write data.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page D-37. If the Write Performance Test fails, replace the media.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select function . Wait for the SCD to change to a flashing .

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing and the test begins.

   - If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
   - If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 2: Update Drive Firmware from FMR Tape

Attention: When updating drive firmware, do not power-off the drive until the update is complete or the firmware may be lost.

Function Code loads drive firmware from a field microcode replacement (FMR) tape. The FMR tape must have been created from a LTO Gen4 tape drive with the same host interface (SCSI U160, SCSI U320, SAS, or Fibre Channel).

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing .
4. Insert the FMR tape cartridge. The SCD changes to a flashing . The tape drive loads the updated firmware from the FMR tape into its erasable programmable read-only memory (EPROM) area.
   - During the reboot the SCD presents a series of random characters. The SCD briefly displays , then becomes blank (not lit) when POST is complete, The Status Lights will be amber during the reboot and change to green after a successful reboot.
   - If the update completes successfully, the tape drive rewinds and unloads the FMR tape, resets itself, and is ready to use the new firmware. The drive automatically reboots.
   - If the update fails, the tape drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. The drive then unloads the FMR tape and exits maintenance mode after the cartridge is removed. Contact Technical Support for problem determination or machine replacement.

Function Code 3: Create FMR Tape

Function Code copies the drive's field microcode replacement (FMR) data to a scratch data cartridge. The resulting FMR tape can only be used to update the firmware on other LTO Gen4 tape drives with the same host interface (SCSI U160, SCSI U320, SAS, or Fibre Channel).

Attention: For this function, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing .
4. Insert a scratch (blank) data cartridge that is not write protected (or the tape drive exits maintenance mode). The SCD changes to a flashing . The tape drive copies the FMR data to the scratch data cartridge.
   - If the tape drive creates the FMR tape successfully, it rewinds and unloads the new tape, exits Maintenance Mode, and the tape is ready to use .
   - If the tape drive fails to create the FMR tape, it displays an error code. To determine the error, see "Drive Error Codes" on page D-42. The tape drive then unloads the FMR tape, and exits Maintenance Mode after the cartridge is removed.

Function Code 4: Force a Drive Dump

Function Code performs a dump of data collected by the drive (this process is also known as saving a microcode trace).

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The drive performs the dump. The SCD shows 0, then goes blank. To access the contents of the dump, see "Function Code 5: Copy Drive Dump."

   Note: You can also force a drive dump when the tape drive is in normal operating mode. Simply press and hold the Unload Button for ten seconds. This causes the drive to reboot.

Function Code 5: Copy Drive Dump

Function Code 5 copies data from a drive dump (captured in Function Code 4) to the beginning of a scratch (blank) data cartridge.

Attention: For this function, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code 7 appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code P appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until 5 appears in the SCD. If you cycle past the desired code, press the Unload Button once per second until the code reappears.
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. Then press the Unload Button once per second to cycle through the following functions:
   - 5 - 0 : no function
   - 5 - 1 : copy dump to tape
   - 5 - 2 : copy dump to flash memory
   - 5 - 3 : erase flash memory

   If you cycle past the desired code, press the Unload Button once per second until the code reappears.
4. Press and hold the Unload Button for three or more seconds, then release it to select one of the above functions.
5. If you selected 5 - 0 the drive will exit Maintenance Mode. If you selected 5 - 2 or 5 - 3 the SCD will change to a flashing 5 while the procedure is being performed. After the procedure is completed the drive will exit

Maintenance Mode. If you selected 5 - 1 the SCD will change to a flashing C indicating that a data cartridge is to be inserted.

6. Insert a scratch (blank) data cartridge that is not write protected (or the tape drive exits maintenance mode). The SCD flashes the selection number while performing the function.
   - If the copy operation completes successfully, the tape drive rewinds and unloads the tape, and exits Maintenance Mode after the cartridge is removed.
   - If the copy operation fails, an error code appears in the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. The tape drive unloads the tape cartridge and exits Maintenance Mode after the cartridge is removed.

Function Code 6: Run Host Interface Wrap Test

Approximate Run Time = 10 seconds per loop

Number of Loops = This test runs until stopped by pressing the Unload Button.

Function Code 6 performs a check of the host interface circuitry and host connector on the drive.

Note: This test requires that SCSI drives be terminated by either the terminator on the connector or at the end of the bus. Before you select this function, disconnect the SCSI cable of the drive that is closest to the server. Then attach the SCSI wrap plug to that SCSI connector.

1. Make sure that the host interface wrap plug is connected to the host interface connector at the rear of the drive.
2. If the drive is a SCSI drive, make sure that the drive is terminated at its SCSI connector or at the SCSI bus.
3. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
4. Press the Unload Button once per second until 6 appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
5. Press and hold the Unload Button for three or more seconds, then release it to select the function. The drive automatically starts the test. The SCD will display a flashing 6 during the test.
   - If no error is detected, the diagnostic will exit Maintenance Mode, 0 temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
   - If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 7: Run RS-422 Wrap Test

This test causes the drive to perform a check of the circuitry and connector for the RS-422 interface. This connector supports the Library Drive Interface (LDI) and the Automation Drive Interface (ADI).

Before selecting this function, attach an LDI or RS-422 wrap plug to the drive's LDI or RS-422 connector (in place of the LDI or RS-422 cable).

1. Make sure that no cartridge is in the drive, and the appropriate wrap plug is attached to the RS-422 connector.
2. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
3. Press the Unload Button once per second until appears in the Single-character Display (SCD). If you cycle past , continue to press the Unload Button until it displays again.
4. To select the function, press and hold the Unload Button for three seconds.

   After you select the function, flashes and the drive automatically starts the test.

   - If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
   - If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 8: Unmake FMR Tape

Function Code erases the field microcode replacement (FMR) data and rewrites the cartridge memory on the tape. This converts the cartridge into a valid scratch (blank) data cartridge.

1. Place the drive in maintenance mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select function . The SCD changes to a flashing .
4. Insert the FMR data cartridge (or the tape drive exits maintenance mode). The SCD changes to a flashing . The tape drive erases the firmware on the tape and rewrites the header in the cartridge memory to change the cartridge to a valid scratch (blank) data cartridge:

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

- If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
- If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 9: Display Error Code Log

Function Code displays the last ten error codes, one at a time (the codes are ordered; the most recent is presented first and the oldest is presented last). If there are no errors in the log, function code displays in the Single-character Display (SCD) and exits Maintenance Mode.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to view the most recent error code.
4. Press the Unload Button again to view successive error codes. Let two to three seconds pass between each depression. The SCD will display when all the error codes have been displayed.
5. After viewing all error codes, exit this function by pressing the Unload Button again. The SCD will display and exit Maintenance Mode.

Function Code A: Clear Error Code Log

Function Code erases the contents of the error code log.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. A flashes in the SCD, followed by 0. The tape drive erases all errors from the error code log and exits Maintenance Mode.

Function Code C: Insert Cartridge into Tape Drive

This function cannot be selected by itself, but is part of other maintenance functions (such as Run Tape Drive Diagnostics and Create FMR Tape) that require a tape cartridge to be inserted.

Function Code E: Test Cartridge & Media

Approximate Run Time = 15 minutes per loop

Total Number of Loops = 10

Function Code E performs tests that determine whether a suspect cartridge and its magnetic tape are acceptable.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: When you perform this test, data on the suspect tape will be overwritten.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code 7 appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code P appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see “Entering Maintenance Mode” on page D-28.
2. Press the Unload Button once per second until E appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing C.
4. Ensure that the write-protect switch on the suspect cartridge is off, then insert the cartridge (or the tape drive exits maintenance mode). The SCD changes to E. The tape drive runs the tests.
   - If no error is detected, the diagnostic will exit Maintenance Mode, 0 temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)

- If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code F: Write Performance Test

Approximate Run Time = 5 minutes

Total Number of Loops = 10

Function Code F performs tests to ensure that the drive can read from and write to tape.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code 7 appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code P appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance mMode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until F appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing C.
4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing F and the tape drive runs the tests.

   Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code 7 appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code P appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

- If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
- If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in “Drive Error Codes” on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code H: Test Head

Approximate Run Time = 10 minutes per loop

Total Number of Loops = 10

Function Code performs tests to ensure that the tape drive's head and tape-carriage mechanics work correctly.

Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run “Function Code F: Write Performance Test” on page D-37. If the Write Performance Test fails, replace the media.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see “Entering Maintenance Mode” on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing .
4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing . The tape drive runs the tests.

- If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
- If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in “Drive Error Codes” on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code J: Fast Read/Write Test

Approximate Run Time = 5 minutes per loop

Total Number of Loops = 10

Function Code performs tests to ensure that the drive can read from and write to tape.

Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run “Function Code F: Write Performance Test” on page D-37. If the Write Performance Test fails, replace the media.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g. Gen 1, WORM media, or non-FMR cartridge), error code appears in the SCD and the amber Fault status light flashes. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Gen2 media), error code appears in the SCD. Press the Unload Button. The tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see “Entering Maintenance Mode” on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing .
4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing and the tape drive runs the tests.

- If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
- If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code L: Load/Unload Test

Approximate Run Time = 15 seconds per loop

Total Number of Loops = 10

Function Code tests the drive's ability to load and unload a tape cartridge.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: Even though no data is written during this test, it is recommended that you use a blank (scratch) cartridge for this test.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing .
4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing and the tape drive runs the tests.

   - If no error is detected, the diagnostic will exit Maintenance Mode, temporarily appears in the SCD, and the drive returns to Operational Mode (SCD blank, Green Ready/Activity status light ON, and the Amber Fault status light is OFF)
   - If an error is detected, the Fault status light flashes amber and the drive posts an error code to the SCD. To determine the error, locate the code in "Drive Error Codes" on page D-42. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code P: Post Error Reporting Enabled

When Post Error Reporting is enabled, deferred-check conditions are reported to the host and temporary errors are reported in the sense data. Function Code will be displayed in Maintenance Mode when the drive has Post Error Reporting enabled.

This selection is normally used as a request from support personnel.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until either or appears in the SCD. or will appear in the SCD to indicate the current setting for Post Error Reporting. If you cycle past the desired code, press the Unload Button once per second until the code reappears.
3. Exit Maintenance Mode if you do not want to change the current setting for Post Error Reporting. For instructions, see "Exiting Maintenance Mode" on page D-28.
4. To disable Post Error Reporting, Press and hold the Unload Button for three seconds while appears in the SCD. The SCD changes to after you release the Unload Button.
5. Press the Unload Button once per second to select another Maintenance Mode Function. To exit Maintenance Mode, refer to "Exiting Maintenance Mode" on page D-28.

Function Code U: Post Error Reporting Disabled

When Post Error Reporting is disabled, deferred-check conditions are not reported to the host and temporary errors are not reported in the sense data. This is the normal (default) setting for the drive. When the drive has Post Error Reporting disabled, Function Code will be displayed in Maintenance Mode. The drive will default to Post Error Reporting disabled after a reboot or power off/on cycle.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page D-28.
2. Press the Unload Button once per second until either or appears in the SCD. or will appear in the SCD to indicate the current setting for Post Error Reporting. If you cycle past the desired code, press the Unload Button once per second until the code reappears.
3. Exit Maintenance Mode if you do not want to change the current setting for Post Error Reporting. For instructions, see "Exiting Maintenance Mode" on page D-28.
4. To disable Post Error Reporting, Press and hold the Unload Button for three seconds while appears in the SCD. The SCD changes to after you release the Unload Button.
5. Press the Unload Button once per second to select another Maintenance Mode Function. To exit Maintenance Mode, refer to "Exiting Maintenance Mode" on page D-28.

Drive Error Codes

Table D-11 gives descriptions of the errors and messages that pertain to the drive, and tells what to do when you receive them.

Attention: If the drive detects a permanent error and displays an error code other than 0, it automatically performs a drive dump. If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn OFF the power to the drive or you may lose the dump data.

- Make note of the SCD error code prior to removing a cartridge or clearing the SCD error code.
- If an error occurred with a cartridge in the drive, push the Unload Button to eject the cartridge.
- To clear the SCD error code and power cycle the drive, press the Unload Button for ten seconds. A drive dump will be created.

Attention: If the drive detects a permanent error and displays an error code other than 0, it automatically performs a drive dump. If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn off the power to the drive or you may lose the dump data.

Table D-11. Error codes on the Single-character Display

Error Code	Cause and Action
0	No error occurred and no action is required. This code displays when diagnostics have finished running and no error occurred. **Note:** The Single-character Display is blank during normal operation of the tape drive.
1	Temperature problem. The tape drive detected that the recommended operating temperature was exceeded. Perform one or more of the following actions: • Ensure that the cooling fan is rotating and is quiet. If not, refer to your enclosure documentation. • Remove any blockage that prevents air from flowing freely through the tape drive. • Ensure that the operating temperature and airflow is within the specified range (refer to the tape drive specifications in this manual). Clear the error code by power cycling the tape drive or placing the drive in Maintenance Mode. If the operating temperature and airflow are within the specified range, and the problem persists, replace the drive.
2	Power problem. The tape drive detected that the externally supplied power is outside the specified voltage limits (the tape drive is not operating). Perform the following action: 1. Ensure that the power connector is properly seated. 2. Ensure that the proper dc voltages are being applied within the tolerances allowed (refer to the tape drive specifications in this manual). 3. If the proper voltages are not being applied, service the power supply. 4. If the proper voltages are being applied, power OFF/ON the tape drive to see if the problem repeats. 5. Replace the tape drive if the problem persists. The error code clears when you place the tape drive in maintenance mode.

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
3	Firmware problem. The tape drive determined that a firmware error occurred. Perform the following action: 1. Collect a drive dump from one of the following: **Note:** Do not force a new dump; the tape drive has already created one. • Server's host interface by using a device driver utility or system tool (for instructions about reading a drive dump from tape, visit the Web at **http://www.ibm.com/storage/lto**) • Ultrium Tape Drive (to copy and read a drive dump, use "Function Code 5: Copy Drive Dump" on page D-32) 2. Power the tape drive OFF and ON, then retry the operation that produced the error. 3. If the problem persists, download new firmware and retry the operation. 4. If the problem persists, send the drive dump that you collected in step **1** to your IBM Support Center. The error code clears when you place the tape drive in maintenance mode.
4	Firmware or hardware problem. The tape drive determined that a firmware or tape drive hardware failure occurred. Perform the following action: 1. Collect a drive dump from one of the following: **Note:** Do not force a new dump; one already exists. • Server's host interface by using a device driver utility or system tool (for instructions about reading a drive dump from tape, visit the Web at **http://www.ibm.com/storage/lto**) • Ultrium Tape Drive (to copy and read a drive dump, use "Function Code 5: Copy Drive Dump" on page D-32) 2. Power the tape drive OFF and ON, then retry the operation that produced the error. The error code clears when you place the tape drive in maintenance mode. 3. If the problem persists, download new firmware and retry the operation; if new firmware is not available, replace the drive.
5	Tape drive hardware problem. The drive determined that a tape path or read/write error occurred. To prevent damage to the drive or tape, the tape drive will not allow you to insert a cartridge if the current cartridge was successfully ejected. The error code may clear when you cycle power to the tape drive or place it in maintenance mode. If the problem persists, replace the drive. **Note:** Copy the drive dump to flash memory before returning the drive. For instructions, refer to "Function Code 5: Copy Drive Dump" on page D-32.
6	Tape drive or media error. The tape drive determined that an error occurred, but it cannot isolate the error to faulty hardware or to the tape cartridge. Ensure the tape cartridge is the correct media type: • Ultrium -1 tape cartridges are not supported in Ultrium-4 tape drives. • Drive will not accept an expired Cleaning Cartridge. • Drive will not accept a WORM cartridge when running diagnostic tests in Maintenance Mode. • Drive will not write over existing datasets on a WORM cartridge. Ensure you are appending datasets on WORM media rather than attempting to write over existing datasets. If the tape cartridge is the correct media type, perform the following action:

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
	For Problems with Writing Data: If the problem occurred while the tape drive was writing data to the tape, retry the operation with a different cartridge: • If the operation succeeds, the original cartridge was defective. Copy data from the defective cartridge and discard it. • If the operation fails and another tape drive is available, insert the cartridge into the other unit and retry the operation. – If the operation fails, discard the defective cartridge. – If the operation succeeds, insert a scratch data cartridge into the first unit and run "Function Code 1: Run Drive Diagnostics" on page D-29. - If the diagnostics fail, replace the tape drive. - If the diagnostics succeed, the error was temporary. • If the operation fails and another tape drive is not available, insert a scratch data cartridge into the unit and run "Function Code 1: Run Drive Diagnostics" on page D-29. – If the diagnostics fail, replace the tape drive. – If the diagnostics succeed, discard the cartridge. If the problem occurs with multiple tape cartridges, run "Function Code 1: Run Drive Diagnostics" on page D-29: • If the diagnostics fail, replace the tape drive. • If the diagnostics succeed, run"Function Code H: Test Head" on page D-38. – If the diagnostic fails, replace the tape drive. – If the diagnostic succeeds, replace the cartridges that caused the problem. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode. **For Problems with Reading Data:** If the problem occurred while the tape drive was reading data from the tape, perform one of the following procedures: • If another tape drive is available, insert the cartridge into the other unit and retry the operation: – If the operation fails, discard the defective cartridge. – If the operation succeeds, insert a scratch data cartridge into the first unit and run "Function Code 1: Run Drive Diagnostics" on page D-29: - If the diagnostic fails, replace the tape drive. - If the diagnostic succeeds, the error was temporary. • If another tape drive is not available, insert a scratch data cartridge into the unit and run "Function Code 1: Run Drive Diagnostics" on page D-29: – If the diagnostic fails, replace the tape drive. – If the diagnostic succeeds, discard the cartridge. If the problem occurs with multiple tape cartridges, run "Function Code 1: Run Drive Diagnostics" on page D-29: • If the diagnostic fails, replace the tape drive. • If the diagnostic succeeds, run "Function Code H: Test Head" on page D-38. – If the diagnostic fails, replace the tape drive. – If the diagnostic succeeds, replace the cartridges that caused the problem. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
7	Media error. The tape drive determined an error occurred because of a faulty tape cartridge or an invalid tape cartridge. Ensure the tape cartridge is the correct media type: • Ultrium -1 tape cartridges are not supported in Ultrium-4 tape drives. • Drive will not accept an expired Cleaning Cartridge. • Drive will not accept a WORM cartridge when running diagnostic tests in Maintenance Mode. • Drive will not write over existing datasets on a WORM cartridge. Ensure you are appending datasets on WORM media rather than attempting to write over existing datasets. If the tape cartridge is the correct media type, try another tape cartridge. If the problem occurs with multiple tape cartridges, use the following procedure: 1. If possible, run the tape cartridge in a different tape drive. If the operation in the other unit fails and 6 or 7 displays, replace the media. If the operation succeeds, run "Function Code 1: Run Drive Diagnostics" on page D-29. **Attention:** When you run the Test Cartridge & Media diagnostic, data on the suspect tape is overwritten. Use only a scratch data cartridge to run the test. • If the diagnostic fails, replace the drive. • If the diagnostic succeeds, clean the drive head (refer to the drive cleaning operation in this manual) and run "Function Code 1: Run Drive Diagnostics" on page D-29. – If the drive diagnostic fails, replace the drive. – If the drive diagnostic succeeds, perform the operation that produced the initial media error. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.
8	Interface problem. The tape drive determined that a failure occurred in the tape drive's hardware or in the host bus. Refer to the problem solving information in this manual. If 8 was displayed while running "Function Code 6: Host Interface Test": 1. Verify the correct interface wrap tool was attached during the test. The test will fail if the correct interface wrap tool is not attached. 2. If the correct interface wrap tool was attached during the test, replace the drive. The error code clears when you place the tape drive in maintenance mode. **Note:** The error code clears 10 seconds after the drive detected the error or when you place the drive in maintenance mode.
9	Tape drive or RS-422 error. The tape drive determined that a failure occurred in the tape drive's hardware or in the RS-422 connection. See "Function Code 7: Run RS-422 Wrap Test" on page D-34 or refer to the Library procedures to isolate the problem to the drive. The error code clears when you place the tape drive in maintenance mode.

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
A	Degraded operation. The tape drive determined that a problem occurred which degraded the operation of the tape drive, but it did not restrict continued use. If the problem persists, determine whether the problem is with the drive or the media. **Note:** The drive is usable, though the Single-character Display continues to indicate an error and the Status Light flashes amber. The error code may clear when you cycle power to the tape drive or place it in maintenance mode. To determine if the problem is with the drive hardware, or the tape media, perform the following procedures: 1. If possible, run the tape cartridge in a different drive. If the operation in the other drive fails and 6 or 7 displays, replace the media. If the operation succeeds, run the Test Cartridge & Media diagnostic (see "Function Code E: Test Cartridge & Media" on page D-36). 2. If the Test Cartridge & Media diagnostic fails, replace the media. If it runs successfully, clean the failing drive and run the drive diagnostics (refer to the drive cleaning information in this manual and "Function Code 1: Run Drive Diagnostics" on page D-29). Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page D-37. If the Write Performance Test fails, replace the media.If the drive diagnostics run successfully, perform the operation that produced the initial drive error. 3. If the problem persists replace the drive. If it is not possible to run the tape cartridge in a different drive, perform the following procedures: 1. Clean the failing drive and run the drive diagnostics (refer to the drive cleaning information in this manual and "Function Code 1: Run Drive Diagnostics" on page D-29). Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page D-37. If the Write Performance Test fails, replace the media.If the drive diagnostics run successfully, run the Test Cartridge & media diagnostic (see "Function Code E: Test Cartridge & Media" on page D-36). 2. If the Test Cartridge & Media diagnostic fails, replace the media. If it runs successfully, perform the operation that produced the initial drive error. 3. If the problem persists replace the drive.
C	The tape drive needs to be cleaned. Clean the tape drive. Refer to the drive cleaning information in this manual. The error code clears when you clean the tape drive or place it in maintenance mode.
d	Fiber AL_PA conflict. Two drives on fiber loop have the same AL_PA. Modify the tape drive AL_PA to eliminate the conflict.

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
	Encryption Error. Displayed when the drive detects an error associated with a encryption operation. If the problem occurred while the tape drive was writing data to, or reading data from, tape: 1. Check the host application to ensure the host application is providing the correct encryption key. • Refer to the *IBM Tape Device Drivers Encryption Support* documentation and the *IBM LTO Ultrium Tape Drive SCSI Reference* documentation for the Sense Data returned for an encryption operation. • Retry the encryption operation after the host application problems have been resolved. 2. Check the operation of the tape drive by resetting the drive and running POST. • Refer to the error code displayed on the SCD if the drive reset and POST fails. • Retry the encryption operation if the drive reset and POST complete without errors. 3. Check the media. • Ensure the correct media is being used. Data encryption is supported with LTO Ultrium 4 Data Cartridges only. • Retry the encryption operation with the tape cartridge in another encryption enabled drive. Replace the media if the problem repeats with the same tape cartridge in multiple drives. If the problem occurred while the tape drive was running POST or diagnostics, replace the drive. The error code clears with the first attempted write/read after the encryption key is changed, or when the drive is placed in maintenance mode.
	Fiber Port offline. Displayed when the drive fiber port has received a 'port bypass' command from another port on the fiber channel network. 1. Verify the fiber cables and connections, between the tape drive and the host, are the correct type and are working properly. Verify all equipment and devices are powered ON. 2. Verify the configuration settings for the drive are set correctly, and are compatible with the topology of the network. 3. Verify the host fiber adapter and port are working properly, and are compatible with the topology of the network. 4. Verify the fiber channel switch ports are working properly, and are compatible with the topology of the network. 5. Verify the drive fiber cable and connector are plugged into port-0 of the tape drive. 6. Verify tape drive fiber port-0 is working properly by running “Function Code 6: Run Host Interface Wrap Test” on page D-33. The error code clears when communication is restored, or when you place the tape drive in maintenance mode.

Table D-11. Error codes on the Single-character Display (continued)

Error Code	Cause and Action
F	Fiber Channel Error. No Light Displayed if the drive fiber port does not detect light. 1. Verify the fiber cables and connections, between the tape drive and the host, are the correct type and are working properly. Verify all equipment and devices are powered ON. 2. Verify the configuration settings for the drive are set correctly, and are compatible with the topology of the network. 3. Verify the host fiber adapter and port are working properly, and are compatible with the topology of the network. 4. Verify the fiber channel switch ports are working properly, and are compatible with the topology of the network. 5. Verify the drive fiber cable and connector are plugged into port-0 of the tape drive. 6. Verify tape drive fiber port-0 is working properly by running “Function Code 6: Run Host Interface Wrap Test” on page D-33. The error code clears when the drive detects light, or when you place the tape drive in maintenance mode.
P	Write operation to a write protected cartridge has been attempted (this includes any attempt to overwrite a WORM protected tape). Ensure the tape cartridge is the correct media type. Writes to Ultrium-2 tape cartridges are not supported in Ultrium-4 tape drives. If the tape cartridge is the correct media type, check the write-protect switch on the cartridge. The drive will not write to a write-protected cartridge. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

Resolving Tape Drive Problems

If you encounter problems when running the Ultrium Tape Drive, refer to the table below. If the problem is not identified, refer to “Methods of Receiving Errors and Messages” on page D-49.

Table D-12. Troubleshooting Tips for the Ultrium Tape Drive

If the problem is this....	Do this....
A code displays on the single-character display.	The Ultrium Tape Drive detected an error or is directing you to an informational message. See “Drive Error Codes” on page D-42.
The status light or single-character display never turns ON.	The Ultrium Tape Drive has not been properly terminated or has no power. If the SCSI bus is terminated externally, try a different terminator or use the drive's internal termination. If the SCSI bus is terminated properly, check the power at the power source. Ensure the tape drive sled is connected properly, (see “Drive Sled” on page 7-42). If the problem persists, replace the tape drive sled.

Table D-12. Troubleshooting Tips for the Ultrium Tape Drive (continued)

If the problem is this....	Do this....
The Ultrium Tape Drive won't load a tape cartridge.	One of the following has occurred: • A tape cartridge is already inserted. To remove the cartridge, press the unload button. If the cartridge does not eject, turn OFF the power to Ultrium Tape Drive, then turn it back ON and press the unload button. • The tape cartridge was inserted incorrectly. • The tape cartridge was defective. Insert another tape cartridge. If the problem persists, replace the tape drive sled (see "Drive Sled" on page 7-42). • The Ultrium Tape Drive has no power. Ensure the drive sled is plugged into the Library correctly. (See "Drive Sled" on page 7-42.) If there are multiple drives in the library and the other drives are powered up correctly, suspect the power cable or power distribution card. • If the problem exists for multiple cartridges, the Ultrium Tape Drive is defective. Replace the tape drive (see "Drive Sled" on page 7-42).
The Ultrium Tape Drive won't unload the tape cartridge.	The tape cartridge is stuck or is broken. Press the unload button. If the cartridge does not eject, turn OFF the power to Ultrium Tape Drive, then turn it back ON. If the cartridge still does not eject, manually remove it (see "Manual Cartridge Removal from a Drive" on page 7-132).
The host received TapeAlert messages.	See Appendix A, "TapeAlert Flags Supported by the Drive," on page A-1.
The host reported SCSI problems (such as selection or command time-outs, or parity errors).	See Appendix E, "Message Retrieval at the Host," on page E-1.
A library reported an interface problem.	Run drive diagnostics. The drive sled or RS-422 circuitry may be defective. Refer to the section about running drive diagnostics in the *Setup and Operator Guide*.
Codes display on the single-character display, but the status light doesn't turn ON.	The Ultrium Tape Drive is defective. Replace the tape drive sled, (see "Drive Sled" on page 7-42).

Methods of Receiving Errors and Messages

Use the table below as a guide for identifying error and message codes reported to the Ultrium Tape Drive, library, or host.

Note: The codes on the single-character display have different meanings, depending on whether they display during normal operations or while the drive is in maintenance mode. Codes that occur during normal operations are defined in "Drive Error Codes" on page D-42. Codes that occur while in maintenance mode are defined in "Diagnostic and Maintenance Functions" on page D-26.

Table D-13. Methods of Receiving Errors and Messages for the Ultrium Tape Drive

If the error or message was presented by....	Do this....
The library's display (if the tape drive is enclosed in a library or autoloader)	See Chapter 1, "Start Service," on page 1-1.
The tape drive's single-character display and the status light flashes yellow	See "Drive Error Codes" on page D-42. To determine the meaning of status light activity, see "Status Light" on page D-2.

Table D-13. Methods of Receiving Errors and Messages for the Ultrium Tape Drive (continued)

If the error or message was presented by....	Do this....
The tape drive's single-character display and the status light is solid yellow	See "Diagnostic and Maintenance Functions" on page D-26.
SCSI log sense data (such as TapeAlert flags) or request sense data at the host console	See: • Appendix A, "TapeAlert Flags Supported by the Drive," on page A-1 • "Drive Error Codes" on page D-42 • Appendix E, "Message Retrieval at the Host," on page E-1 • "Drive Sense Data" on page B-6 • "Using Host Sense Data"
Drive sense data sent to a library (if the tape drive is enclosed in a library)	See: • Chapter 1, "Start Service," on page 1-1 • Appendix E, "Message Retrieval at the Host," on page E-1 • "Drive Sense Data" on page B-6 Then see "Drive Error Codes" on page D-42.
The tape drive's error log	See: • "Drive Error Codes" on page D-42 • "Viewing the Drive Error Log" on page D-51

Using Host Sense Data

The table below lists the hosts to which the Ultrium Tape Drive attaches. It gives the operating system for each host and describes how the host records errors from the drive.

To determine the meaning of host sense data, see Appendix E, "Message Retrieval at the Host," on page E-1 and Appendix B, "Sense Data," on page B-1. Also refer to the *IBM Ultrium Device Drivers Installation and User's Guide* or visit the web at **http://www.ibm.com/storage/lto**.

Table D-14. Host Method of Recording Tape Drive Errors

Host	Operating System	Method of Recording Tape Drive Errors
IBM AS/400 or iSeries	OS/400	Records tape drive errors and associated sense data in the AS/400 problem and error logs. View the logs by using the System Service Tools application and the userid QSRV.
IBM RS/6000, RS/6000/SP, or pSeries	AIX	Uses the IBM Atape device driver (provided with the Ultrium Tape Drive) to record tape drive errors and sense data in the host error log. View the host error log by using one or more of the following utilities: tapeutil, diag, smit, or errpt.
HP	HP-UX	Uses the IBM device driver for HP. Error and trace logging are proprietary to Hewlett-Packard.
Sun Microsystems	Solaris	Uses the IBM device driver for Solaris to post sense information to the Solaris host-wide messages file */var/adm/messages*.
Intel-based PCs	Windows-based operating systems	Uses the NTUTIL device driver to log some sense data in the Event Viewer host log.

Viewing the Drive Error Log

The Ultrium Tape Drive keeps an error log that you can use to identify and correct errors. The log contains the 10 most recent error codes, which appear (one at a time) on the single-character display.

To view the drive error log:

1. Make sure that no cartridge is in the drive.
2. Within a 1 second interval press the unload button 3 times. The status light becomes solid amber, indicating that the drive is in maintenance mode.

   Note: If a cartridge is in the drive, it will eject the first time that you press the unload button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, perform the preceding step.
3. Press the unload button once per second until **9** appears in the single-character display.

   Note: If you cycle past the desired code, press the unload button once per second until the code redisplays.
4. Press the unload button to view the most recent error code.
5. Refer to "Drive Error Codes" on page D-42 to determine the meaning of the code and the action to take.
6. Press the unload button to view the next error code. (The codes are ordered; the most recent is presented first and the oldest (tenth) is presented last. Each time you press the unload button to view an error, the single-character display turns ON, the error displays, then the single-character display turns OFF.)
7. Continue to press the unload button until the 10 error codes have been displayed. After you display the tenth error code, the Ultrium Tape Drive automatically exits maintenance mode.

To re-display the error codes, repeat steps 1 - 7.

This function is also available from the Operator Panel by selecting **Tools** > **All Operator Interventions**.

Fixing SCSI Bus Problems

If this is a new installation, or the customer has updated their host hardware or software, verify that the SCSI device driver is installed properly. Refer to device driver documentation.

Attention: In the following procedures you need to know the module (control module or expansion unit) and location number(s) of the failing drive(s).

Table D-15. SCSI Bus Problems

For Error Type...	See...
Solid Error - One Drive	"Fixing a Solid Error with One Drive on a SCSI Bus" on page D-52
Solid Error - Multiple Drives	"Fixing a Solid Error with Multiple Drives on a SCSI Bus" on page D-52
Intermittent Error - One Drive	"Fixing an Intermittent Error with One Drive on a SCSI Bus" on page D-53

Table D-15. SCSI Bus Problems (continued)

For Error Type...	See...
Intermittent Error - Multiple Drives	"Fixing an Intermittent Error with Multiple Drives on a SCSI Bus" on page D-54

Fixing a Solid Error with One Drive on a SCSI Bus

1. Verify that the power is ON to the drive:
   a. Verify that the library is powered ON.
   b. Verify that the power supplies (in the module containing the failing drive) are ON.
   c. Verify that the drive is fully seated in the library chassis.
2. Determine if the drive is experiencing a hang condition.
   a. If a tape cartridge is in the drive, press the unload button.
      - If the cartridge ejects, the drive does not have a hang condition, go to step 5.
      - If the cartridge does not eject, go to step 3.
   b. If there is no cartridge in the drive, manually load a scratch cartridge into the failing drive. If the cartridge loads, the drive does not have a hang condition. Press the unload button to unload the scratch cartridge and go to step 5.
3. Press and hold the unload button for 20 seconds. The drive will save a dump and go into a reboot, which allows communication to the drive. Do not cycle power (power OFF then power ON) or you will lose the dump contents.
4. Obtain a drive dump (see "Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool" on page 6-28). Contact your next level of support to determine if they can use this dump. go to "End of Call" on page 6-47.
5. Ensure that the SCSI cables are plugged in and tightened.
6. Ensure that the drive SCSI address is the same as the SCSI address being used by host system. From the Operator Panel, select **Reports** > **Library Configuration**. View the SCSI ID for the affected drive. If the SCSI ID is different then expected, you must either change the drive SCSI ID or reconfigure the host.
7. Perform "Diagnostic and Maintenance Functions" on page D-26.
   a. If the test fails, replace the:
      - Drive sled
      - SCSI terminator
   b. If the test runs successfully, replace the:
      - SCSI terminator
      - SCSI host-to-drive cable
      - Interposer (if installed)

      If the failure still exists, it probably is caused by the host system hardware or software. Refer to the service documentation for the host system.

Fixing a Solid Error with Multiple Drives on a SCSI Bus

1. Verify that the power is ON to the drives:
   a. Verify that the library is powered ON.

b. Verify that all the circuit protectors on all Power Supplies are ON.

2. Verify that the SCSI cables are plugged in and tightened.
3. Ensure that the drive SCSI address is the same as the SCSI address being used by host system. From the Operator Panel, select **Reports** > **Library Configuration**. View the SCSI ID for the affected drive. If the SCSI ID is different then expected, you must either change the drive SCSI ID or reconfigure the host.
4. If only one drive is failing on this SCSI bus, go to step 5. If more than one drive is failing on this SCSI bus, go to 6.
5. Replace the following CRU:
   - Drive sled

   If the problem is corrected, return to the procedure that sent you here or go to "End of Call" on page 6-47. If the failure still exists, go on to step 6.
6. Verify that the SCSI cable from the host system to the first drive is connected.
7. Disconnect the drive-to-drive SCSI cable from the first drive and replace with the terminator.
8. Run a utility (such as ITDT) to determine whether you can communicate with the first drive. If you cannot communicate with the drive, perform "Function Code 6: Run Host Interface Wrap Test" on page D-33.
   - If the SCSI Wrap Test runs successfully, replace the following:
     - SCSI terminator
     - SCSI host-to-host cable
     - Interposer (if installed)
     - Drive-to-drive SCSI cable (except for the first drive)

     If the failure still exists, it probably is caused by the host system hardware or software, refer to the service documentation for the host system.
   - If the SCSI Wrap Test fails or does not correct the problem, replace the following:
     - Drive sled
     - SCSI terminator
     - If the problem still exists, contact your next level of support.
   - If the error does not occur, reconnect one drive at a time back to the SCSI bus, and repeat step 8 for each drive.

     Note: Ensure that the SCSI terminator is always on the last drive on the failing SCSI bus.

Fixing an Intermittent Error with One Drive on a SCSI Bus

1. Verify that the latest level firmware is installed on the drive. Update the firmware, if necessary.

   Required library firmware and drive firmware can be downloaded by visiting http://www.ibm.com/storage/lto.
2. Check host error logs to determine if a specific cartridge is causing the problem. Replace the cartridge that is listed as being faulty.
3. If the problem still exists, replace the following:
   - SCSI terminator
   - SCSI host cable
   - Drive sled

If the failure still exists, it probably is caused by the host system hardware or software. Refer to the service documentation for the host system.

Fixing an Intermittent Error with Multiple Drives on a SCSI Bus

1. Verify that the latest level firmware is installed on the drive. Update the firmware, if necessary.

   Required library firmware and drive firmware can be downloaded by visiting http://www.ibm.com/storage/lto.
2. Check host error logs to determine if a specific cartridge is causing the problem. Replace the cartridge that is listed as being faulty.
3. If the problem still exists, replace the following:
   - SCSI terminator
   - SCSI host cable
   - SCSI drive-to-drive cables

   If the failure still exists, it probably is caused by the host system hardware or software. Refer to the service documentation for the host system.

Fixing Fibre Channel Errors

If you are connected to a Fibre Channel Storage Area Network (SAN) by using a SAN Data Gateway, use the *IBM Storage Area Network Gateway Module Setup, Operator, and Service Guide* to determine whether the problem is occurring between the drive and the SAN Data Gateway. If you are using a SCSI drive and are having SCSI problems, see "Fixing SCSI Bus Problems" on page D-51.

Supported Topologies

The Ultrium 3 and Ultrium 4 tape drives can be attached in a two-node configuration, either directly to a switch as a public device (switched fabric) or directly to a host bus adapter (HBA) as a private device. It can do so in a Point-to-Point topology (through an N_port or F_port) or Arbitrated Loop topology (through an L_port or FL_port).

The Ultrium 3 and Ultrium 4 tape drives automatically configure to an L_port or an N_port when it boots. The type of port to which it configures depends on whether the drive recognizes the connection as a loop or a point-to-point connection:

- An L_port supports a Fibre Channel Arbitrated Loop connection to an NL_port or FL_port.
- An N_port supports direct connection to another N_port or to an F_port (for example, a director-class switch) in a point-to-point topology.

Regardless of the port to which you connect the drive, it automatically configures to a public device (through an F_port or FL_port to a switch) or to a private device (through an N_port or L_port by using direct attachment to a server).

The table below lists the topologies in which the Ultrium 3 and Ultrium 4 tape drives can operate, the Fibre Channel server connections that are available, and the port (NL, N, FL, or F) through which communication must occur.

Table D-16. Choosing the port for your topology and Fibre Channel connection

Type of Topology	Type of Fibre Channel Connection to Server	
	Direct Connection (Private)	**Switched Fabric (Public)**
Fibre Channel-Arbitrated Loop(can be Two-Node Arbitrated Loop or Two-Node Switched Fabric Loop; is limited to two nodes)	L_Port	FL_Port
Point-to-Point(two nodes)	N_Port	F_Port

Starting Problem Determination

Before starting the problem determination, perform the following steps:

1. Determine the type of Fibre Channel topology that you are using. Ensure that the drive and the port to which it is attached are configured in compatible topologies.
2. Using this guide or the service guides of associated switch, hub, or fiber products, try to determine where the problem exists (whether in the drive, cable, or the device to which the drive and cable attach).
3. Ensure that the configuration and software levels are supported. To determine the latest supported attachments or to get a comprehensive list of compatible software, visit **http://www.ibm.com/storage/lto.**
4. Ensure that the Fibre Channel cables are installed correctly.
5. Go to one of the following procedures:
   - "Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop"
   - "Fixing a Consistent Error with Multiple Drives on a Fibre Channel Loop" on page D-56
   - "Fixing a Consistent Error in a Point-to-Point Topology" on page D-56
   - "Fixing Intermittent Fibre Channel Errors" on page D-57

Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop

1. Ensure that the tape drive is powered ON.
2. Verify that the tape drive's serial number is the same as the drive serial number that the server program is using.
3. Ensure that the drive's Fibre Channel AL_PA is set correctly, that it is on the loop, and that it is not being used by another device. The tape drive must be able to detect light and communicate with the server.
4. Run the Fibre Channel wrap test at the drive's Fibre Channel connector (see Function Code 6 in "Function Code 6: Run Host Interface Wrap Test" on page D-33).
   - If the test fails, replace the tape drive.
   - If the test is successful, go to step 5..
5. Run the Fibre Channel wrap test at the end of the fiber cable (see Function Code 6 in "Function Code 6: Run Host Interface Wrap Test" on page D-33).
   - If the test fails, replace the fiber cable.
   - If the test is successful, go to step 6.
6. Check the Fibre Channel cable connection at the server.

7. Using a device driver utility such as *ntutil* or *tapeutil*, verify that the drive is properly configured and available at the server.
8. If the problem persists, the fault may be with the server's hardware or software. Refer to your server's service manual.
9. When the problem is corrected (or determined to be a server problem), restore all of the fiber cables to their correct position.

Fixing a Consistent Error with Multiple Drives on a Fibre Channel Loop

Use the following procedure to determine if all of the drives on the Fibre Channel have the problem:

1. Use a device driver utility (such as *ntutil* or *tapeutil*) to verify that the drive is available and properly configured at the server.
2. Determine the type of Fibre Channel topology that you are using.
3. Using this guide or the service guides of associated switch, hub, or fiber products, try to isolate which part of the Fibre Channel Storage Area Network (SAN) is experiencing problems.
4. Perform one of the following:
   - If the problem exists on a small number of drives, go to "Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop" on page D-55.
   - If the problem exists with a large number of drives, perform the following steps:
     a. Disconnect all except one failing drive on the Fibre Channel.
     b. Run the Fibre Channel wrap test to determine if a failure occurs on that drive (see Function Code 6 in "Function Code 6: Run Host Interface Wrap Test" on page D-33). If it does, perform the procedure in "Fixing a Consistent Error with a Single Drive on a Fibre Channel Loop" on page D-55.
     c. Continue to connect one drive at a time to the Fibre Channel loop.
5. When the problem is corrected, restore all of the Fibre Channel cables to their correct position.

Fixing a Consistent Error in a Point-to-Point Topology

1. Ensure that the tape drive is powered ON.
2. Verify that the tape drive's serial number is the same as the drive serial number that the server program is using.
3. Ensure that the drive is connected to the host or switch. The drive must be able to detect light and communicate with the server.
4. Run the Fibre Channel wrap test at the drive's Fibre Channel connector (see Function Code 6 in "Function Code 6: Run Host Interface Wrap Test" on page D-33).
   - If the test fails, replace the tape drive.
   - If the test is successful, go to step 5.
5. Run the Fibre Channel wrap test at the end of the fiber cable (see Function Code 6 in "Function Code 6: Run Host Interface Wrap Test" on page D-33).
   - If the test fails, replace the fiber cable.
   - If the test is successful, go to step 6.
6. Check the Fibre Channel cable connection at the server.

7. Using a device driver utility such as *ntutil* or *tapeutil*, verify that the drive is properly configured and available at the server.
8. If the problem persists, the fault may be with the server's hardware or software. Refer to your server's service manual.
9. When the problem is corrected (or determined to be a server problem), restore all of the fiber cables to their correct position.

Fixing Intermittent Fibre Channel Errors

1. Determine the type of Fibre Channel topology that you are using.
2. Ensure that the configuration and software levels are supported.
   a. Determine the current software levels by selecting **Reports->Library Configuration**.
   b. Download the latest levels of software by visiting **http://www.ibm.com/storage/lto**.
3. Check that each Fibre Channel cable does not exceed 500 m (1640 ft).
4. Ensure that all Fibre Channel cables are installed correctly.
5. Using this guide or the service guides of associated switch, hub, or fiber products, determine that a problem exists between the drive, drive cable, and the device to which they attach. Try to isolate which part of the Storage Area Network (SAN) is experiencing problems.
6. Using this guide or the service guides of associated switch, hub, or fiber products, verify that the SAN configurations are correct (such as switch zoning for drive sharing).
7. Obtain all errors reported by the drive to the server (see "Using Host Sense Data" on page D-50), then contact your OEM Product Application Engineer (PAE) for error analysis.

Fixing SAS Interface Problems

If your drive is attached to the host through a SAS cable to a host bus adapter (HBA), the following procedures will assist you isolation and correction of any interface problems. SAS attachment requires no topology changes as is found in fibre channel attachment, and requires no external termination as is required in SCSI attachment. In addition, SAS drives are attached individually to the HBA, either through a one-to-one connection or through an interposer. You need not worry about another drive causing this drive to fail. As such, SAS attachment is by far the easiest interface to understand and to correct problems.

Currently, the SAS interface provides 3 Gb/s maximum speed over the interface. In the future, the ability to perform a diagnostic wrap of the signal will be provided. In the meantime, isolation will depend upon whether the problem is solid or intermittent. If the problem you are having is solid, refer to "Fixing a Solid Error with One Drive on a SAS Connection". If the problem you are having is intermittent, refer to "Fixing an Intermittent Error with One Drive on a SAS Connection".

The LTO-4 SAS drives use an SFF-8088 type connector. Each SAS tape drive should be connected directly to a SAS host bus adapter (HBA) using one SAS cable. The library does not support the use of SAS expander devices or cables at this time.

Fixing a Solid Error with One Drive on a SAS Connection

1. Verify that the power is ON to the drive.
   a. Verify that the library is powered ON.
   b. Verify that the power supplies (in the module containing the failing drive) are ON.
   c. Verify that the drive is fully seated in the library chassis.
2. Determine if the drive is experiencing a hang condition.
   a. If a cartridge is in the drive, press the unload button.
      - If the cartridge ejects, the drive does not have a hang condition, go to step 5.
      - If the cartridge does not eject, go to step 3.
   b. If there is no cartridge in the drive, manually load a scratch cartridge into the failing drive. If the cartridge loads, the drive does not have a hang condition. Press the unload button to unload the scratch cartridge and go to step 6.
3. Press and hold the unload button for 20 seconds. The drive will save a dump and go into a reboot, which allows communication to the drive. Do not cycle power (power OFF then power ON) or you will lose the dump contents.
4. Copy the Drive Dump with one of the following procedures
   - If the drive is no longer hung (cartridge can be unloaded), refer to "Diagnostic and Maintenance Functions" on page D-26 and collect the dump on a scratch (blank) cartridge.
   - If the drive is still hung, refer to "Using the ITDT SCSI Firmware Update, Dump Retrieval and Drive Test Tool" on page 6-28 to secure the dump using ITDT. Contact your next level of support to determine if they can use this dump.
5. If the problem continues to be in the drive, replace the failing drive sled. Refer to "Drive Sled" on page 7-42. When complete, go to "End of Call" on page 6-47.
6. Ensure that the SAS cables or interposers are plugged in and tightened at both ends.
7. Ensure that the drive element address is the same as the element address being used by the host system. From the Operator Panel, select **Reports** > **Library Configuration**.
8. If another SAS drive is available, do the following:
   a. Quiece the library from all activity and swap the drives.
   b. If the problem stays with the suspect drive, replace the drive sled.
   c. If the problem moves to the new drive, replace the SAS cable or interposer.
   d. If the problem still exists after performing the above procedures, suspect a host system hardware or software problem. Refer to the service documentation for the host system.
   e. Go to "End of Call" on page 6-47.
9. If another SAS drive is not available to swap, replace the SAS cable or interposer.
10. If the problem still exists, replace the drive sled. If this does not fix the problem, suspect that the problem is caused by host system hardware or software. Refer to the service documentation for the host system.
11. Go to "End of Call" on page 6-47.

Fixing an Intermittent Error with One Drive on a SAS Connection.

1. Verify that the latest level of firmware is installed on the drive. Update the firmware, if necessary. Required library firmware and drive firmware can be downloaded by visiting http://www.ibm.com/storage/LTO.
2. Check host error logs to determine if a specific cartridge is causing the problem. Replace the cartridge that is listed as being faulty.
3. Check that the SAS cable length does not exceed the 5.5 meters (plus the short length of an interposer if used) allowed. Try a shorter cable (if possible) to see if it makes any difference.
4. If the intermittent failure still occurs, replace the drive sled. See "Drive Sled" on page 7-42.

Appendix E. Message Retrieval at the Host

Retrieving messages from different hosts is discussed in this appendix.

"Obtaining Error Information From an RS/6000"

"Retrieving from an AS/400 System with RISC Processor" on page E-7

"Retrieving from a Sun System" on page E-8

"Retrieving from an HP-UX System" on page E-8

Obtaining Error Information From an RS/6000

IBM device drivers for the RS/6000 system logs error information when an error occurs on a tape drive or library.

The error information includes the following:

1. Device VPD
2. SCSI command parameters
3. SCSI sense data (if available)

The AIX Tape and Media Changer Device Driver for the RS/6000 provides logging to the system error log for a variety of errors. You can view the error log by following this procedure.

1. At the AIX command line, type **errpt |pg** to display a summary report, or type **errpt -a |pg** to display a detailed report. Press **[Enter]**.

   Note: In most cases you will use the summary report to find the date and time of any errors related to library devices, then use the detail report to obtain the sense data needed to identify the cause of the error.
2. Press **[Enter]** to scroll through the error log.
3. Type **q** and press **[Enter]**, to quit the error log at any time.

To correct a problem you noticed in the **errpt** report, determine the type of error by using the examples that follow:

- For library errors [Resource Name = **smc**n (for example, smc0) and Resource Type = 3576]), refer to "Library Error Log Example" on page E-2 and locate the SCSI sense data.
- For drive errors [Resource Name = **rmt**n (for example, rmt0) and Resource Type = LTO], refer to "Drive Error Log Example" on page E-3 and locate the SCSI sense data.
- For SCSI bus errors (not SCSI adapter errors), refer to "SCSI Bus Error Example 1" on page E-4 and "SCSI Bus Error Example 2" on page E-5 to determine which host adapter, SCSI bus, and device or devices are affected.
- For Fibre Channel errors (not Fibre Channel adapter errors), determine which host adapter and device are affected.
- For SCSI adapter errors (not SCSI bus errors), use the maintenance package for the host.

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Note: See "Drive Sense Data" on page B-6 for further details on sense data.

Library Error Log Example

```
LABEL: TAPE_ERR2
IDENTIFIER: 476B351D
Date/Time: Wed Oct 11 11:42:17
Sequence Number: 25265
Machine ID: 000D090D4C00
Node ID: tsm
Error Class: H
Error Type: PERM
Resource Name: smc0
Resource Class: tape
Resource Type: 3576
Location: 40-60-00-6,0
VPD:
Manufacturer................IBM
Machine Type and Model......ULT3576-TL
Serial Number...............IBM7810698
Device Specific . (FW) .....x.xx (Firmware Level)
Description
TAPE DRIVE FAILURE
Probable Causes
TAPE DRIVE
Failure Causes
TAPE
TAPE DRIVE
Recommended Actions
PERFORM PROBLEM DETERMINATION PROCEDURES
Detail Data
SENSE DATA
0C00 0000 A500 0001 1009 0101 0000 0000 0000 0000 7000 0400 0000 0046 0000 0000
4400 8100 0000 0000 0000 0000 0000 0200 4801 E300 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

Figure E-1. AIX ERRPT Library Error Log Example

Table E-1. AIX ERRPT Library Sense Data

Hex	Description
A5	SCSI Command
0001, 1009, 0101	Command Parameters
70	Byte 0 of Library Sense Data
04	Sense Key
4400	ASC/ASCQ (Additional Sense Code/Additional Sense Code Qualifier)
81	Library SAT (Service Action Ticket) Code

Drive Error Log Example

```
LABEL: TAPE_ERR1
IDENTIFIER: 4865FA9B
Date/Time: Wed Oct 10 11:39:43
Sequence Number: 25264
Machine ID: 000D090D4C00
Node ID: tsm
Class: H
Type: PERM
Resource Name: rmt2
Resource Class: tape
Resource Type: LTO
Location: 40-60-00-2,0
VPD:
Manufacturer................IBM
Machine Type and Model......ULT3576-TD3
Serial Number...............1300015078
Device Specific.(FW)........xxxx (Firmware Level)
Description
TAPE OPERATION ERROR
Probable Causes
TAPE
User Causes
MEDIA DEFECTIVE
DIRTY READ/WRITE HEAD
Recommended Actions
FOR REMOVABLE MEDIA, CHANGE MEDIA AND RETRY
PERFORM PROBLEM DETERMINATION PROCEDURES
Detail Data
SENSE DATA
0602 0000 0100 0000 0200 0000 0000 0000 0000 0000 7000 0300 0000 001C 0000 0000
5200 0700 20B0 0000 0000 0000 0000 0000 0000 0000 058A 0212 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

Figure E-2. AIX ERRPT Drive Error Log Example

Table E-2. AIX ERRPT Drive Sense Data

Hex	Description
01	SCSI Command
0000, 0200, 0000	Command Parameters
70	Byte 0 of Tape Drive Sense Data
03	Sense key (Hardware error in this example)
5200	ASC/ASCQ (Additional Sense Code/Additional Sense Code Qualifier)
20B0	FSC (Fault Symptom Code)
058A	Relative LPOS
02	SCSI ID

SCSI Bus Error Example 1

```
LABEL: SCSI_ERR10
IDENTIFIER: 0BA49C99
Date/Time: Wed Oct 17 09:55:32
Sequence Number: 16140
Machine Id: 00003ABF4C00
Node Id: ofgtsm
Class: H
Type: TEMP
Resource Name: scsi3
Resource Class: adapter
Resource Type: sym896
Location: 40-59
VPD:
Product Specific.( ).......DUAL CHANNEL PCI TO ULTRA2 SCSI
ADAPTER
Part Number.................03N3606
EC Level....................F71335
Manufacture ID..............A16592
Serial Number...............0749
Description
SCSI BUS ERROR
Probable Causes
CABLE
CABLE TERMINATOR
DEVICE
ADAPTER
Failure Causes
CABLE LOOSE OR DEFECTIVE
DEVICE
ADAPTER
Recommended Actions
PERFORM PROBLEM DETERMINATION PROCEDURES
CHECK CABLE AND ITS CONNECTIONS
Detail Data
SENSE DATA
0001 0017 0000 0000 0000 0091 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 4304 0000 0000 0000 0000 2000 0003 0203 6760 9808 0000 F7FB E1B8
0000 0015 000B 0210 0678 C800 0000 8200 8277 1B20 00A2 ED00 0000 0002 FFFF FFFF
00FF 0000 111F F000 F3DF F110
```

Figure E-3. Example of Error Suggesting SCSI Bus Problem, Which Takes Down Entire Bus

SCSI Bus Error Example 2

```
LABEL: TAPE_ERR4
IDENTIFIER: 5537AC5F
Date/Time: Wed Oct 17 09:00:41
Sequence Number: 16101
Machine Id: 00003ABF4C00
Node Id: ofgtsm
Class: H
Type: PERM
Resource Name: smc0
Resource Class: tape
Resource Type: 3576
Location: 40-58-00-0,1
VPD:
Manufacturer................IBM
Machine Type and Model......ULT3576-TL
Serial Number...............IBM7810698
Device Specific.(FW)........x.xx
Description
TAPE DRIVE FAILURE
Probable Causes
ADAPTER
TAPE DRIVE
Failure Causes
ADAPTER
TAPE DRIVE
Recommended Actions
PERFORM PROBLEM DETERMINATION PROCEDURES
Detail Data
SENSE DATA
0600 0000 1200 0000 FF00 0000 0000 0000 0200 0800 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

Figure E-4. SCSI Problem Points to Library Control Path as Possible Cause

Summary Report

```
1 2 34 5 6
FFE2F73A 1012150900 U H rmt5 UNDETERMINED ERROR
0BA49C99 1012150800 T H scsi8 SCSI BUS ERROR 7
C60BB505 1012141500 P S SOFTWARE PROGRAM ABNORM TERMINATED
C42F11D4 1012105200 U S VSC:DE SOFTWARE ERROR
C42F11D4 1012105000 U S VSC:DE SOFTWARE ERROR
FFFA352B 1012104900 U S MS:CS SOFTWARE ERROR
FFFA352B 1012104900 U S MS:CS SOFTWARE ERROR
5537AC5F 1012091700 P H rmt9 TAPE DRIVE FAILURE
5537AC5F 1012091700 P H rmt9 TAPE DRIVE FAILURE
5537AC5F 1012091700 P H rmt9 TAPE DRIVE FAILURE
5537AC5F 1012091600 P H rmt8 TAPE DRIVE FAILURE
5537AC5F 1012091600 P H rmt8 TAPE DRIVE FAILURE
5537AC5F 1012091600 P H rmt8 TAPE DRIVE FAILURE
C60BB505 1012082000 P S SOFTWARE PROGRAM ABNORM TERMINATED
C42F11D4 1011183600 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011183300 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011181800 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011174700 U S VSC:DE SOFTWARE ERROR
FFFA352B 1011172900 U S MS:CS SOFTWARE ERROR
FFFA352B 1011172900 U S MS:CS SOFTWARE ERROR
C42F11D4 1011155300 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011153900 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011153800 U S VSC:DE SOFTWARE ERROR
C42F11D4 1011150900 U S VSC:DE SOFTWARE ERROR
```

Figure E-5. AIX ERRPT Commands Error Log Example

NUMBER	DESCRIPTION
1	Error ID
2	Timestamp
3	Error Type
4	Error Class
5	Resource Name
6	Error Description
7	How SCSI Bus Error will Display in Log

ERROR CLASS	DESCRIPTION
H	Hardware
S	Software
O	Informational

ERROR TYPE	DESCRIPTION
PEND	The availability loss of a device or component is imminent.
PERF	The performance of a device or component has degraded to an unacceptable level.
PERM	A hardware or software condition that could not be recovered from.
TEMP	A hardware condition that was recovered from after several unsuccessful attempts.
UNKN	The severity of the condition could not be determined.

A69M0170

Retrieving from an AS/400 System with RISC Processor

IBM device drivers for the AS/400 system logs error information when an error occurs on a tape drive or library.

The error information includes the following:

1. Device VPD
2. SCSI command parameters
3. SCSI sense data (if available)

To gain access to the AS/400 problem logs and error logs, sign on at any available workstation using the QSRV logon and its security password (QSRV). After signing on, the proper access authorizations will be granted and the AS/400 MAIN MENU displays.

1. Type STRSST (Start System Service Tools) command on the command entry line on the AS/400 Main Menu, and press **[Enter]**.
2. On the "System Service Tool (SST)" screen, select **Start a service tool**, and press **[Enter]**.
3. On the "Start a Service Tool" screen, select **Product activity log**, and press **[Enter]**.
4. On the "Product activity log" screen, select **Analyze log**, and press **[Enter]**.
5. On the "Select Subsystem Data" screen, select **Magnetic media**, enter the From and To time period for searching the error log, and press **[Enter]**.
6. On the "Select Analysis Report Options" screen, select the following, and press **[Enter]**.
   a. Report type. 1
   b. Optional entries to include
      1) Informational . . . . . YES
      2) Statistic . . . . . NO
   c. Reference code selection
      1) Option 1
      2) Reference codes. . . . . *ALL
   d. Device selection
      1) Option 1
      2) Device type or resource names . . *ALL
7. On the "Log Analysis Report" screen, enter a **5** on an error line that has a resource type of 3583 (library) or 3580 (drive), and press **[Enter]**.
8. On the "Display Detail Report for Resource" screen, press:
   - F4=Additional Information.

     Pressing F4 will display the machine type and serial number of the device. It also will display SCSI sense data, if available.
   - F6=Hexadecimal report.

     Pressing F6 will display the device hexadecimal data (for support use).
   - F9=Address Information.

     Pressing F9 will display the SCSI address information.

AS/400 Product Activity Log

```
Product Activity Log Page . . . : 1
ROMLPAR1 08/26/05 10:28:40
Invocation . . . . . : Product Activity Log
Title . . . . . : Log ID Report
System type . . . . . : 9406
System model . . . . . : 825
System release . . . . : V5R3M0
System name . . . . . : ROMLPAR1
System serial
number . . . . . : 10-F321B
Log ID . . . . . : 09020145
Include hexadecimal
data . . . . . : Y Y=YES
N=NO
Product Activity Log Page . . . : 2
ROMLPAR1 08/26/05 10:28:40
Detail Report for Resource
Serial Resource
Name Type Model Number Name
TAPMLB19 3580 001 00-1004538
Log ID . . . . . : 09020145 Sequence . . . . . : 211510
Date . . . . . : 04/21/05 Time . . . . . : 10:40:11
Reference code . . . . . : 9350 Secondary code . . . : 00000000
Table ID . . . . . : 63A00001 IPL source/state . . : B / 3
Class . . . . . : Permanent
System ref code . . . . . : 63A09350
Tape unit detected a read or write error on tape medium
Physical location:
Frame ID . . . . . :
Card position . . . . . :
Device position . . . . :
Logical address:
PCI bus: Library:
System bus . . . . . : 36 I/O adapter . . . . . : 2
System board . . . . . : 0 I/O bus . . . . . : 1
System card . . . . . : 32 Library: 20
Controller . . . . . : 4
Device . . . . . : 0
SENSE DATA FOLLOWS. . . . :
DATA OFFSET 0 1 2 3 4 5 6 7 8 9 A B C D E F
00000000 71000300 0000001C 00000000 53000600
00000010 31190601 00020000 00000000 00000000
00000020 00000301
00000000 0000 C5D3F0F5 00000188 00E00180 8983EBC2 4B9D8001 00033A36 20E00902 01450000 *EL05...h....ic.B.............*
00000000 0040 F3F8F2F8 F4F4F6F3 C1F00002 00240000 00200000 00050001 00140004 00000002 *38284463A0.....................*
00000000 0060 00000000 00000000 00000000 40404040 40404040 40400000 00000000 00000000 *............ ..........*
00000000 0080 00000000 00000000 00000000 00000000 00000000 00000000 00000000 0000E3C1 *.............................TA*
00000000 00A0 D7D4D3C2 F1F94040 00000000 00000000 00000000 00000000 40404040 40404040 *PMLB19 ................ *
00000000 00C0 40404040 40404040 40404040 40404040 40404040 40404040 40404040 40404040 * *
00000000 00E0 F6F3C1F0 F0F0F0F1 0000E2D3 C9C3C9D6 4040E5F5 D9F3D4F0 40400000 00000000 *63A00001..SLICIO V5R3M0 ......*
00000000 0100 01030000 00000000 00000141 00000000 00000000 01950000 00000000 00000197 *.....................n.........p*
00000000 0120 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 *..............................*
00000000 0140 E3C1D7F2 F7404040 40404040 40404040 40404040 40404040 40404040 00070001 *TAP27 ....*
00000000 0160 00000000 10200003 00000000 00000000 00000000 00000000 0009001E 00000188 *.............................h*
00000000 0180 F8807800 28440001 00002600 21410400 63A00001 93500100 45381202 05D80000 *8.....................l&.......Q..*
00000000 01A0 00000000 00004624 00000000 00000000 00040000 00003580 0001A170 02903435 *..............................*
Product Activity Log Page . . . : 3
ROMLPAR1 08/26/05 10:28:40
00000000 01C0 36310040 00007100 03000000 001C0000 00005300 06003119 06010002 00000000 *... ............................*
00000000 01E0 00000000 00000000 03010000 00000000 00000000 00000000 00000000 00000000 *..............................*
00000000 0200 00000000 0000D9C5 D8400000 D9E200C 02000000 0000E2C3 E2C91202 00180000 *......REQ ..RS........SCSI......*
00000000 0220 00000000 0000C5D9 D940C3C8 C3D20444 8502D9E2 0000E2C3 E2C91202 00180300 *......ERR CHCK..e.RS..SCSI......*
00000000 0240 00008000 0000E2D5 E2C47100 03000000 001C0000 0000C5D9 D7C11202 05D80000 *......SNSD............ERPA...Q..*
00000000 0260 00171202 05D8D9C5 E2D70000 00171202 05D8D9E2 00000000 D4C5C4C9 C10000C3 *.....QRESP.......QRS....MEDIA..C*
00000000 0280 D7D7F1F2 F5C500D4 E3C1D7C3 D3D500C3 D7D7F6F4 F0F000E4 C6C9F0F0 F8F7F1C3 *PP125E.MTAPCLN.CPP6400.UFI00871C*
00000000 02A0 D7D7F1F8 F5C600D5 00000000 00000000 00000000 00000000 00000000 00000000 *PP185F.N........................*
00000000 02C0 00000000 00000000 00000000 00000000 00000000 00000000 C3D7D7F6 F3F0C3D5 *........................CPP630CN*
00000000 02E0 F6F3C1F0 F9F3F5F0 F0F0F0F0 F0F0F0F0 F0F0F0F0 F0F1F9F7 F8F0F0F7 0000E8D5 *63A0935000000000000001978007..YN*
00000000 0300 00000000 00000000 40404040 40404040 40404040 40404040 40404040 40404040 *........ *
* * * * * E N D O F C O M P U T E R P R I N T O U T * * * * *
```

Retrieving from an HP-UX System

The HP-UX system provides information when an error occurs on a tape drive or library in `syslog /var/adm/syslog.log`. When you have located the error information, refer to the troubleshooting information in this manual.

Retrieving from a Sun System

The Sun System provides information when an error occurs on a tape drive or library in `system-errolog /var/adm/messages`. When you have located the error information, refer to the troubleshooting information in this manual.

The two following service aid programs are provided with the IBM SCSI Tape Device Driver for SunOS:

- Tape service program

  A tape service program called **tapesrvc.c** is provided and contains the following service aids:

  – Query device serial number
  – Format tape cartridge
  – Force device error dump

- Save device error dump
- Download device code

The tape service program is invoked by using the **/opt/stddutil/tapesrvc** command.

Note: You must have root authority to run the tape service program.

The program is menu driven. Use discretion when running this program because it opens the device in diagnostic mode.

- Sample program

  A sample program called **tapetest.c** is provided, which gives a demonstration of the device driver interface usage.

  The sample program is invoked by using the **/opt/stddutil/tapetest** command. The program is useful for verifying that the device driver and the device are functional. The program is menu driven.

Appendix F. SNMP Status MIB Variables and Traps

The two tables in this appendix provide a quick reference for the status MIB variables and status traps.

Table F-1. Status MIB variables

Event	Object ID*	Description
Drive Online/Offline Status	...11.3.1.10	Indicates whether the drive is online or offline. If the drive is offline, use the Operator Panel or Web User Interface to confirm that the drive is varied ON. Also check library power.
Physical Library Online/Offline Status	...14.1	Indicates whether the library is online or offline. Use the Operator Panel or Web User Interface to confirm that the library is online and not being configured.
Robotic Readiness	...14.30.2	Indicates the library robotics ready status. Verify that the module door(s) are closed and that the robotics are online.
Library Main Door	...14.2	Indicates the library main door status.
I/O Station Door Status	...14.3	Indicates the library I/O station door status.
Logical Library Online/Offline Status	...13.2.1.8	Indicates whether a specific logical library is online or offline. You can use the Operator Panel or Web UI to confirm the logical library is online and not being configured.
* Because the front portion of the MIB variable object ID (OID), 1.3.6.1.4.1.3764.1.10.10, is the same for all variables defined in the MIBs, it is omitted in the OID column of this table. For example, the actual OID of the Drive Online/Offline Status variable is 1.3.6.1.4.1.3764.1.10.10.11.3.1.10.		

Table F-2. Status Traps

Event	Trap ID	Description
Starting	1	Indicates that the tape library has started running.
Shutting down	2	Indicates that the library is in the process of being shut down.
Restarting	3	Indicates that the library has been restarted. This does not imply anything about whether the configuration has changed or not (unlike the standard coldStart or warmStart traps).
Startup Sequence Completed	101	Indicates that the library startup sequence has completed.
Shutdown Sequence Completed	102	Indicates that the library shutdown sequence has completed.
Change in Online State	103	Indicates that the online state of the physical library has changed.
Physical Library Door Status Change	104	Indicates whether the physical library door has been opened, closed, locked, or unlocked.
I/O Door Status Change	105	Indicates that an I/O station door has been opened, closed, locked, or unlocked.
Robotics Ready	106	Indicates the library robotics system has transitioned from "not ready" to "ready". Traps 106 and 107 may occur as part of a startup or shutdown procedure. If they occur at another time, a library door may be open.

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Table F-2. Status Traps (continued)

Event	Trap ID	Description
Robotics Not Ready	107	Indicates the library robotics system has transitioned from "ready" to "not ready". Traps 106 and 107 may occur as part of a startup or shutdown procedure. If they occur at another time, a library door may be open.
Logical Library State Change	108	Indicates whether a logical library has been taken online or offline.
RAS Status Change: Connectivity	109	Indicates that the status of the connectivity subsystem (which includes the I/O management unit and other components) has changed. This may indicate a change to "good" status, so refer to the return value to determine what action you should take. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Control	110	Indicates that the status of the control subsystem (which includes system firmware, the operator panel, and the Library Control Blade) has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Cooling	111	Indicates that the status of the cooling subsystem has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Drives	112	Indicates that the status of the drives and/or media has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Media	113	Indicates that the status of the media has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Power	114	Indicates that the status of the power subsystem has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
RAS Status Change: Robotics	115	Indicates that the status of the robotics subsystem has changed. If the return value indicates that a problem exists, use the Operator Panel or Web UI to determine how to resolve the issue.
Operator Intervention Required	116	An error has occurred, resulting in an Operator Intervention message. Use the Operator Panel or Web UI to determine how to resolve the issue.
Drive Online State Change	117	Indicates that a tape drive has been taken online or offline.
Drive Communication Failure	121	The library set TapeAlert 1, indicating a drive communication failure.
Library Hardware Failure	122	The library set TapeAlert 2, indicating a library hardware failure.
Non-mechanical Hardware Failure	124	The library set TapeAlert 4, indicating a non-mechanical hardware failure.
Cartridge Pick Problem	133	The library set TapeAlert 13, indicating a problem when picking a tape cartridge.

Table F-2. Status Traps (continued)

Event	Trap ID	Description
Cartridge Placement Problem	134	The library set TapeAlert 14, indicating a problem when placing a tape cartridge.
Drive Load Problem	135	The library set TapeAlert 15, indicating a problem when loading a tape drive.
Library main Access Door Open	136	The library set TapeAlert 16, indicating an open library access door.
Mailbox Mechanical Problem	137	The library set TapeAlert 17, indicating a mailbox station mechanical problem.
Excessive Scan Retries	143	The library set TapeAlert 23, indicating that excessive scan retries occurred.
Barcode Label Unreadable	152	The library set TapeAlert 32, indicating that a tape cartridge barcode label could not be read.
The library issues a trap whenever the aggregate state of one of the Reliability, Availability, and Serviceability (RAS) status groups changes. Listening for these traps (rather than querying for them) is the preferred method of monitoring the health of the library.		

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Germany Electromagnetic compatibility directive

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Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

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В жилых помещениях оно может создавать
радиопомехи, для снижения которых необходимы
дополнительные меры

rusemi

Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. If you do not find the term you are looking for, refer to the index or to the *Dictionary of Computing*, 1994.

Numbers

2:1 compression
The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2:1 compression, twice as much data can be stored with compression as can be stored without compression.

A

A Ampere.

ac Alternating current.

access method
A technique for moving data between main storage and input or output devices.

adapter card
A circuit board that adds function to a computer.

ADI Automation Drive Interface.

adj Adjustment.

AIX Advanced Interactive Executive. IBM's implementation of the UNIX operating system. The RS/6000 system, among others, uses AIX as it's operating system.

alphanumeric
Pertaining to a character set that contains letters, numerals, and usually other characters, such as punctuation marks.

alter To change.

ambient temperature
The temperature of air or other media in a designated area, particularly the area surrounding equipment.

ampere (A)
A unit of measure for electric current that is equivalent to a flow of one coulomb per second, or to the current produced by one volt applied across a resistance of one ohm.

ANSI American National Standards Institute.

archive
To collect and store files in a designated place.

ASCII American National Standard Code for Information Interchange. A 7 bit coded character set (8 bits including parity check) that consists of control characters and graphic characters.

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assigning a device
The establishing of the relationship of a device to a running task, process, job, or program.

assignment
The naming of a specific device to perform a function.

asynchronous
Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals.

attention (notice)
A word for calling attention to the possibility of danger to a program, device, or system, or to data. Contrast with *caution* and *danger*.

ATTN Attention.

B

backup
To make additional copies of documents or software for safekeeping.

bar code
A code representing characters by sets of parallel bars of varying thickness and separation which are read optically by transverse scanning.

bar code label
Paper bearing a bar code and having an adhesive backing. The bar code label must be affixed to a tape cartridge to enable the library to identify the cartridge and its volume serial number.

bar code reader
A laser device specialized for scanning and reading bar codes and converting them into either the ASCII or EBCDIC digital character code.

bezel Decorative and safety cover.

bicolored
Having two colors.

bit Either of the digits 0 or 1 when used in the binary numbering system.

BM or bill of materials
A list of specific types and amounts of direct materials expected to be used to produce a given job or quantity of output.

BRMS Backup Recovery and Media Services.

browser
A client program that initiates requests to a Web server and displays the information that the server returns.

buffer
A routine or storage used to compensate for a difference in rate of flow of data or time of occurrence of events, when transferring data from one device to another.

bus A facility for transferring data between several devices located between two end points, only one device being able to transmit at a given moment.

byte A string consisting of a certain number of bits (usually 8) that are treated as a unit and represent a character. A fundamental data unit.

C

capacity
The amount of data that can be contained on storage media and expressed in bytes of data.

cartridge manual rewind tool
A device that can be fitted into the reel of a cartridge and used to rewind tape into or out of the cartridge.

CM Cartridge Memory.

cartridge storage slot
Individual slot located within a magazine that is used to house tape cartridges.

caution (notice)
A word to call attention to possible personal harm to people. Contrast with *attention* and *danger*.

CE Customer engineer; field engineer; service representative.

centimeter (cm)
One one-hundredth of a meter (0.01 m). Approximately 0.39 inch.

channel command
An instruction that directs a data channel, control unit, or device to perform an operation or set of operations.

char Character.

CHK Check.

cleaning cartridge
A tape cartridge that is used to clean the heads of a tape drive. Contrast with *data cartridge*.

command
A control signal that initiates an action or the start of a sequence of actions.

compact disc (CD)
A disc, usually 4.75 inches in diameter, from which data is read optically by means of a laser.

compression
The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

concurrent
Refers to diagnostic procedures that can be run on one control unit while the rest of the subsystem remains available for customer applications.

contingent connection
A connection between a channel path and a drive caused when a unit check occurs during an I/O operation.

controller
A device that provides the interface between a system and one or more tape drives.

COD Capacity On Demand.

CP Circuit protector.

CPF Control Path Failover.

CRU Customer Replaceable Unit.

CSA Canadian Standards Association.

ctrl Control.

CU Control unit.

D

danger (notice)
A word to call attention to possible lethal harm to people. Contrast with *attention* and *caution*.

data Any representations such as characters or analog quantities to which meaning is or might be assigned.

data buffer
The storage buffer in the control unit. This buffer is used to increase the data transfer rate between the control unit and the channel.

data cartridge
A tape cartridge dedicated to storing data. Contrast with *cleaning cartridge*.

data check
A synchronous or asynchronous indication of a condition caused by invalid data or incorrect positioning of data.

dc Direct current.

degauss
To make a magnetic tape nonmagnetic by means of electrical coils carrying currents that neutralize the magnetism of the tape.

degausser
A device that makes magnetic tape nonmagnetic.

degradation
A decrease in quality of output or throughput or an increase in machine error rate.

degraded
Decreased in quality of output or throughput or increased machine error rate.

deserialize
To change from serial-by-bit to parallel-by-byte.

detented
A part being held in position with a catch or lever.

device Any hardware component or peripheral, such as a tape drive or tape library, that can receive and send data.

device driver
A file that contains the code needed to use an attached device.

DIAG
Diagnostic section of maintenance information manual.

differential
See *High Voltage Differential (HVD)*.

direct access storage
A storage device in which the access time is independent of the location of the data.

DNS Directory Name System. This allows the library to recognize text-based addresses instead of numeric IP addresses.

download
To transfer programs or data from a computer to a connected device, typically a personal computer.

To transfer data from a computer to a connected device, such as a workstation or microcomputer.

DPF Data Path Failover.

DRAM
Dynamic random-access memory.

drive, magnetic tape
A mechanism for moving magnetic tape and controlling its movement.

DRV Drive.

DSE Data security erase.

DSP Digital signal processor.

E

EBCDIC
Extended binary-coded decimal interchange code.

EC Edge connector. Engineering change.

ECC Error correction code.

EEPROM
Electrically erasable programmable read-only memory.

EIA Electronics Industries Association.

EIA unit
A unit of measure, established by the Electronic Industries Association, equal to 44.45 millimeters (1.75 inches).

eject To remove or force out from within.

EKM Encryption Key Manager.

electronic mail
Correspondence in the form of messages transmitted between user terminals over a computer network.

e-mail See *electronic mail*.

EPO Emergency power off.

EPROM
Erasable programmable read only memory.

EQC Equipment check.

equipment check
An asynchronous indication of a malfunction.

Error log
A dataset or file in a product or system where error information is stored for later access.

ESD Electrostatic discharge.

F

fault symptom code (FSC)
A hexadecimal code generated by the drive or the control unit microcode in response to a detected subsystem error.

FC Feature code.

FCC Federal communications commission.

FE Field engineer, customer engineer, or service representative.

fiducial
A target used for teaching a physical location to a robot.

field replaceable unit (FRU)
An assembly that is replaced in its entirety when any one of its components fails.

file A named set of records stored or processed as a unit. Also referred to as a dataset.

file protection
The processes and procedures established in an information system that are designed to inhibit unauthorized access to, contamination of, or deletion of a file.

file transfer protocol (FTP)
In the Internet suite of protocols, an application layer protocol that uses TCP and Telnet services to transfer bulk-data files between machines or hosts.

firmware
Proprietary code that is usually delivered as microcode as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and more adaptable to change than pure hardware circuitry. An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC motherboard.

FLASH EEPROM
An electrically erasable programmable read-only memory (EEPROM) that can be updated.

FMR Field microcode replacement.

format
The arrangement or layout of data on a data medium.

formatter
Part of a magnetic tape subsystem that performs data conversion, speed matching, encoding, first level error recovery, and interfaces to one or more tape drives.

FP File protect.

frayed Damaged as if by an abrasive substance.

FRU Field replaceable unit.

FSC Fault symptom code.

FSI Fault symptom index.

functional microcode
Microcode that is resident in the machine during normal customer operation.

G

g Gram.

GB gigabyte.

GBIC Gigabit Interface Converter.

Gbi gigabit

gigabit (Gbit)
1 000 000 000 bits.

gigabyte (GB)
1 000 000 000 bytes.

Gigabit Interface Converter (GBIC)
Converts copper interface to optic interface.

gnd Ground.

H

HBA Host Bus Adapter.

hertz (Hz)
Unit of frequency. One hertz equals one cycle per second.

hex Hexadecimal.

High Voltage Differential (HVD)
A logic signaling system that enables data communication between a supported host and the library. HVD signaling uses a paired plus and minus signal level to reduce the effects of noise on the SCSI bus. Any noise injected into the signal is present in both a plus and minus state, and is thereby canceled. Synonymous with *differential*.

HVD SCSI Bus High Voltage Differential

Hz Hertz (cycles per second).

I

IBM LTO Ultrium 4 Half-High Tape Drive
Located within the library, a data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape.

ID Identifier.

identifier (ID)
(1) In programming languages, a lexical unit that names a language object; for example, the names of variables, arrays, records, labels, or procedures. An identifier usually consists of a letter optionally followed by letters, digits, or other characters. (2) One or more characters used to identify or name data element and possibly to indicate certain properties of that data element. (3) A sequence of bits or characters that identifies a program, device, or system to another program, device, or system.

IEC International Electrotechnical Commission.

IML Initial microprogram load.

initial microprogram load (IML)
The action of loading a microprogram from an external storage to writable control storage.

initiator
The component that executes a command. The initiator can be the host system or the tape control unit.

INST Installation.

interface
A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

interposer
The part used to convert a 68-pin connector to a 50-pin D-shell connector.

intervention required
Manual action is needed.

INTRO
Introduction.

I/O Input/output.

IOP Input/output processor.

IPL Initial program load.

ISV Independent Software Vendor.

ITST Idle-time self-test.

K

Kerberos
Kerberos Authentication is a standard (RFC 1510) third-party authentication protocol that provides end-to-end security for distributed computing environments.

kilogram (kg)
One thousand grams (approximately 2.2 pounds).

km kilometer. 1000 Meters, Approximately 5/8 mile.

L

LAN Local area network. A computer network within a limited area.

LCB Library Control Blade

LCD See *liquid crystal display*.

LDAP Lightweight Directory Access Protocol. This allows the library to use login and password information stored on a server to grant access to the library functionality.

LDAPS
Secure LDAP over SSL.

LDI Library Drive Interface.

LED Light-emitting diode.

Linear Tape-Open (LTO)
A type of tape storage technology developed by the IBM Corporation,

Hewlett-Packard, and Certance. LTO technology is an “open format” technology, which means that its users will have multiple sources of product and media. The “open” nature of LTO technology enables compatibility between different vendors' offerings by ensuring that vendors comply with verification standards. The LTO technology is implemented in two formats: the Accelis format focuses on fast access; the Ultrium format focuses on high capacity. The Ultrium format is the preferred format when capacity (rather than fast access) is the key storage consideration. An Ultrium cartridge has a compressed data capacity of up to 800 GB (2:1 compression) and a native data capacity of up to 400 GB.

liquid crystal display (LCD)
A low-power display technology used in computers and other I/O devices.

loadable
Having the ability to be loaded.

LME Library Managed Encryption.

LTO cartridge memory (LTO-CM)
Within each LTO Ultrium data cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.

LUN Logical Unit Number.

LVD SCSI Bus Low Voltage Differential

M

magnetic tape
A tape with a magnetical surface layer on which data can be stored by magnetic recording.

MAP Maintenance analysis procedure.

mask A pattern of characters that controls the retention or elimination of portions of another pattern of characters. To use a pattern of characters to control the retention or elimination of portions of another pattern of characters.

master file
A file used as an authority in a given job and that is relatively permanent, even though its contents may change. Synonymous with main file.

MB Mega Byte (usually expressed as data rate in MB/s or MB/second).

media capacity
The amount of data that can be contained on a storage medium, expressed in bytes of data.

media-type identifier
Pertaining to the bar code on the bar code label of the IBM Ultrium Tape Cartridge, a 2-character code, L1, that represents information about the cartridge. L identifies the cartridge as one that can be read by devices which incorporate LTO technology; 1 indicates that it is the first generation of its type.

mega One million of.

meter In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

micro One millionth of.

microcode
(1) One or more micro instructions. (2) A code, representing the instructions of an instruction set, implemented in a part of storage that is not program-addressable. (3) To design, write, and test one or more micro instructions. (4) See also *microprogram*.

microdiagnostic routine
A program that runs under the control of a supervisor, usually to identify field replaceable units.

microdiagnostic utility
A program that is run by the customer engineer to test the machine.

microinstruction
A basic or elementary machine instruction.

microprogram
A group of microinstructions that when executed performs a preplanned function.

The term microprogram represents a dynamic arrangement or selection of one or more groups of microinstructions for execution to perform a particular function. The term microcode represents microinstructions used in a product as an alternative to hard-wired circuitry to implement certain functions of a processor or other system component.

MIM Media information message.

mm Millimeter.

modifier
That which changes the meaning.

mount a device
To assign an I/O device with a request to the operator.

MP Microprocessor.

ms Millisecond.

MSG Message.

multipath
Pertaining to using more than one path.

N

N/A Not applicable.

NEMA
National Electrical Manufacturers Association.

node In a network, a point at which one or more functional units connect channels or data circuits.

NTP Network Time Protocol. This allows the library to set its internal date and time based on the date and time of a sever.

NVS Nonvolatile storage. A storage device whose contents are not lost when power is cut off.

O

oersted
The unit of magnetic field strength in the unrationalized

centimeter-gram-second (cgs) electromagnetic system. The oersted is the magnetic field strength in the interior of an elongated, uniformly wound solenoid that is excited with a linear current density in its winding of one abampere per 4π centimeters of axial length.

offline
Pertaining to the operation of a functional unit without the continual control of a computer. Contrast with *online*.

online Pertaining to the operation of a functional unit that is under the continual control of a computer. Contrast with *offline*.

OPER Operation.

ov Over voltage.

overrun
Loss of data because a receiving device is unable to accept data at the rate it is transmitted.

overtightening
To tighten too much.

P

parameter
A variable that is given a constant value for a specified application and that may denote the application.

PF Path Failover.

p bit Parity bit.

PC Parity check.

PCC Power control compartment.

PDF Portable Document Format.

PE Parity error. Product engineer.

pick Pertaining to the library, to remove, by means of a robotic device, a tape cartridge from a storage slot or drive.

picker A robotic mechanism located inside the library that moves cartridges between the cartridge storage slots and the drive.

PM Preventive maintenance.

POR Power-on reset.

port A physical connection for communication between the 3590 and the host processor. The 3590 has two SCSI ports.

Portable Document Format (PDF)
A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact, can be distributed globally (via e-mail, the Web, intranets, or CD-ROM), and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

PROM
Programmable read only memory.

PS Power supply.

PWR Power.

R

rack A unit that houses the components of a storage subsystem, such as the library.

rackmount kit
A packaged collection of articles used to install the rack mounted version of the library.

RAM Random access memory.

Random access memory
A storage device into which data is entered and from which data is retrieved in a nonsequential manner.

RAS Reliability, availability, and serviceability.

record A collection of related data or words, treated as a unit.

recording density
The number of bits in a single linear track measured per unit of length of the recording medium.

recoverable error
An error condition that allows continued execution of a program.

ref Reference.

reg Register.

reinventory
To inventory again.

retension
The process or function of tightening the tape onto the cartridge, if it is sensed that the tape has a loose wrap on the cartridge.

RID tag
Repair identification tag.

robot Picker.

robotics
Picker assembly.

RPQ Request for price quotation.

R/W Read/write.

S

s Seconds of time.

SAC Service Action Code. Code developed to indicate possible FRU or FRU's to replace to repair the hardware.

SAN Storage Area Network.

SAS Serial Attached SCSI. A computer bus technology and serial communication protocol for direct attached storage devices. SAS is a replacement for parallel SCSI with higher speeds, but still using SCSI commands.

scratch cartridge
A data cartridge that contains no useful data, but can be written to with new data.

SCD Single Character Display.

SCSI Small computer system interface.

segment
A part.

sel Select.

serialize
To change from parallel-by-byte to serial-by-bit.

serializer
A device that converts a space distribution of simultaneous states representing data into a corresponding time sequence of states.

servo, servos
An adjective for use in qualifying some part or aspect of a servomechanism.

servomechanism
A feedback control system in which at least one of the system signals represents mechanical motion.

Small Computer Systems Interface (SCSI)
A standard used by computer manufacturers for attaching peripheral devices (such as tape drives, hard disks, CD-ROM players, printers, and scanners) to computers (servers). Pronounced "scuzzy". Variations of the SCSI interface provide for faster data transmission rates than standard serial and parallel ports (up to 320 megabytes per second). The variations include:

- Fast/Wide SCSI: Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1: Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2: Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra SCSI: Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI: Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra160 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra320 SCSI: Uses a 16-bit bus and supports data rates of 320 MBps.

SMI-S See *Storage Management Initiative Specification (SMI-S)*.

SMTP Simple Mail Transfer Protocol. SMTP is a standard for e-mail transmissions across the internet.

SNMP
Simple Network Management Protocol. SNMP is used by network management systems to monitor network-attached devices for conditions that warrant administrative attention.

SMW Servo Manufacturer's Word.

SNS Sense.

special feature
A feature that can be ordered to enhance the capability, storage capacity, or performance of a product, but is not essential for its basic work.

SR Service representative, see also *CE*.

SRAM
Static random access memory.

SS Status store.

SSP Serial SCSI Protocol.

ST Store.

standard feature
The significant design elements of a product that are included as part of the fundamental product.

START
Start maintenance.

StartTLS
Secure LDAP communication using TLS.

Storage Management Initiative Specification (SMI-S)
A storage standard developed and maintained by the Storage Networking Industry Association (SNIA). It has also been ratified as an ISO standard. The main objective of SMI-S is to enable broad interoperable management of heterogeneous storage vendor systems.

subsystem
A secondary or subordinate system, usually capable of operating independently of, or asynchronously with, a controlling system.

SUPP Support.

sync Synchronous, synchronize. Occurring with a regular or predictable time relationship.

T

tachometer, tach
A device that emits pulses that are used to measure/check speed or distance.

tape cartridge
A container holding magnetic tape that can be processed without separating it from the container.

tape void
An area in the tape in which no signal can be detected.

TCP/IP
Transmission Control Protocol/Internet Protocol.

TCU Tape control unit.

TH Thermal.

thread/load operation
A procedure that places tape along the tape path.

TM Tapemark.

U

UART Universal asynchronous receiver/transmitter.

UL Underwriter's Laboratories.

unload
Prepare the tape cartridge for removal from the drive.

utilities
Utility programs.

utility programs
A computer program in general support of the processes of a computer; for instance, a diagnostic program.

uv Under voltage.

V

VOLSER
Volume serial number.

volume
A certain portion of data, together with its data carrier, that can be handled conveniently as a unit.

VPD Vital product data. The information contained within the tape drive that requires nonvolatile storage used by functional areas of the drive, and information required for manufacturing, RAS, and engineering.

W

word A character string that is convenient for some purpose to consider as an entity.

WORM
Write Once Read Many.

Write Write command.

WT world trade.

WWCID
World Wide Cartridge Identifier.

WWN World Wide Name.

WWNN
World Wide Node Name.

WWPN
World Wide Port Name.

X

XR External register.

XRA External register address register.

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